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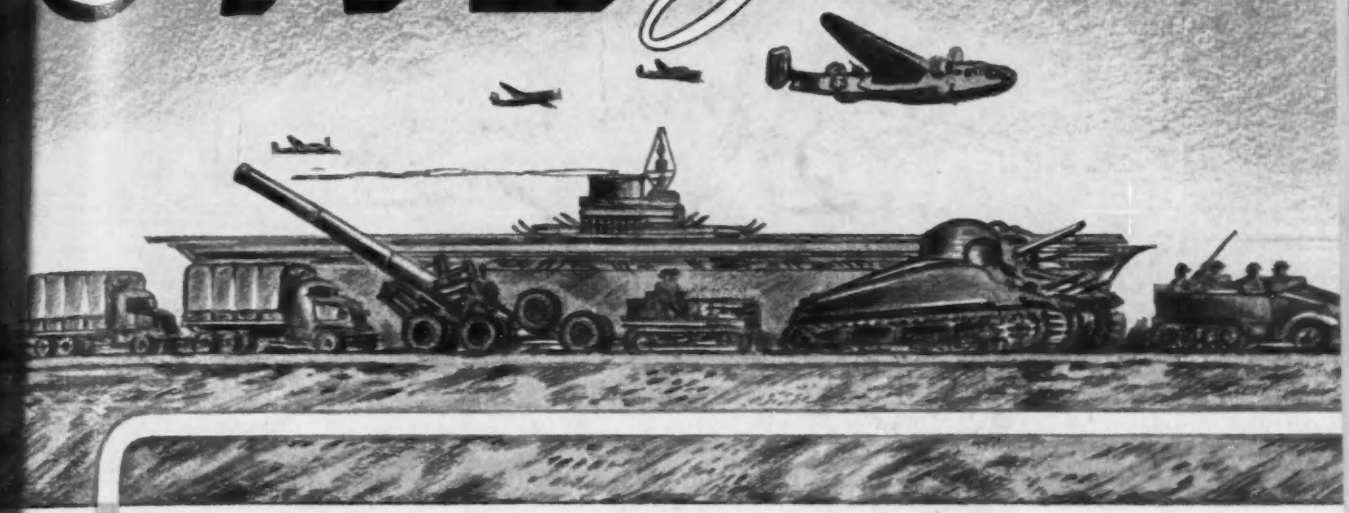
S·A·E Journal



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SOCIETY OF AUTOMOTIVE ENGINEERS

To the Courage of Men Who Won't Say "Can't"

AT THE OUTBREAK of this war, American automotive engineers were confronted with problems that seemed almost impossible of solution.

The fact that those problems *have been* and *are being* solved is eternal tribute to the courage of those men—the kind of courage that won't say "can't."

America owes them more than most of us realize—because the complete story must not yet be told. But the day will come when it can be told. Then the entire nation will be as proud of its automotive engineers as we of Perfect Circle are proud of the privilege of close association with them.

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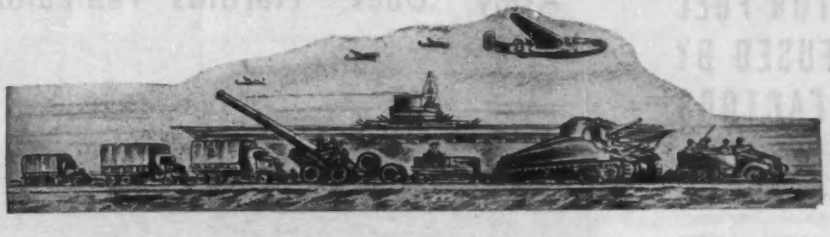

News of the MAY *Issue*

By Norman G. Shidle

Means and Ends

THERE is often a noticeable lack of permanency about objectives attained by people who flaunt the theory that "the end justifies the means."

High level employment attained by producing needed goods and services spawns seeds of stability; attained by leaf-raking and boondoggling it breeds the fungus of its own decay. A conference decision high-pressured by coloring or unfair selection of facts has a way of bogging down in subsequent operation. Executive power gained by stealing credit for achievements of subordinates constantly quivers on foundation of sand.

We know one young man whose progress in his company was rapid up to a place of considerable executive responsibility. He finally quit and went elsewhere because his boss had consistently praised and advanced him for achievements which the man himself thought of little value and because his most important contributions never evoked understanding or appreciation.

Groups in which decision has *come about* by actual meeting of minds are likely to be strong on follow-through. Where decision has been *brought about* by domination of a single personality, the group is only a little stronger in action than that single personality.

The wise leader often will relax pressure to permit a group decision to *come about* rather than gain time by insisting on *bringing it about*.

Machiavelli and more modern "smoothies" notwithstanding, the means used to gain an end makes a very great deal of difference.

Cooperation for Security in Wartime Producing Mutual Benefits for Peace

STRANGE bedfellows are found within the armed forces of both the United Nations and Axis, indicating that war, man's most combative activity, may produce amazing cooperation. Similarly, mechanized war unites for patriotic endeavor the competitive elements of manufacturing industries. In both cases thought prevails that temporary sacrifice of individualism is the cheap price of group security.

There are those who say the post-war will find this cooperative spirit perpetuated. They see competition for business keener than ever, but also a fence separating the sales arena from large areas of mutual interest, fertile for cooperation, and economically tilled for mutual peacetime benefits.

Preview of possibilities, as related to technological cooperation for mutual improvement of commonly used materials, such as steel, will be presented in May *SAE Journal*. W. P. Eddy, Jr., materials engineer, Pratt & Whitney, will review the effects of wartime metallurgical progress on future steels. He will indicate what happens – and what can happen – when competitive barriers are leveled to permit free interchange of technical information between companies and between industries.

Mr. Eddy will list some of the benefits of putting, instead of knocking, heads together, such as:

- Fatigue endurance of parts improved by increasing steel hardness beyond limits previously thought practicable.
- Weights reduced, performances improved, by distinguishing between needs for toughness, high elastic limits, ultimate strength.
- Lower alloy and carbon steels frequently – and economically – replacing deep-hardened high-alloys for some stressed parts.
- Fatigue life extended by avoiding stress concentrations, using shot-peening and other applications of compressive stress to surfaces.
- Principles and rules of annealing postulated for precision, with operating time and costs reduced, machinability improved, new applications developed.
- Application of known principles of steel melting and deoxidation, flow of molten metals, cooling phenomena, radiographic techniques, effecting improvements in steel castings, reducing costs, saving metals, diversifying applications.
- Welding progressed from art to science by trading data, with large financial savings in assembling operations, and indications that wartime all-welded ships and tanks are predecessors of peacetime all-welded transportation equipment, machinery, and structures.
- Cooperative development of precise evaluation of alloying elements assuring conservation of alloys, more intelligent specification of materials, more economical selection of steels.
- Hardenability made so useful an index that, once steelmakers develop adequate controls and consumers recognize satisfactory ranges, hardenability specifications will parallel chemical composition.
- "Needled steels," still experimental, producing startling savings in alloying elements, permitting use of low-alloy and carbon steels for high production parts.
- Adoption and use of "National Emergency" steels conserving alloys and materials, simplifying requirements, expediting and augmenting production.

Air Carriers Must Rely On Speed to Compete in Post-War Transportation

MAN'S adventure with air transport already shows signs of threatening to revise some of his ideas of transportation economics. There are indications that air transport planes not only must, but will, rely upon speed to gain competitive advantage over surface transport. Also, there are indications that, while speed reputedly is costly, the faster a transport plane delivers its cargo the lower the ton-mile cost – within limits, of course.

Such ideas contribute enlivening controversial touches to air transportation economics and to airline operating theories. Why prolong the last 250 miles of a 1500-mile flight when the plane can land the sooner? Why risk weather conditions and other operating hazards by observing constant-speed techniques? Why penalize a flight crew with complicated cruising controls?

In May *SAE Journal* J. G. Borger, of Pan American Airways System, gives his answers to some of these questions. Mr. Borger will say that since speed can be designed into planes and planes can be operated at speed, air transport should take advantage of speed to meet intensified post-war competition by surface transport, which is itself becoming speed conscious.

POST-WAR MOTOR FUEL PICTURE CONFUSED BY CONFLICTING FACTORS

PROLIFIC of conjecture are post-war motor fuels. For purposes of argument also they offer delightfully satisfactory issues necessarily based upon presumptive reasoning, circumstantial evidence, personal theories and preferences, the course of war, and other vagaries.

Since the post-war is a definite date on no calendar, and in the interim both engines and fuels may undergo extensive changes, the tide of debate can flow to please the pros and ebb to satisfy the cons, making everybody happy at some time or other.

May *SAE Journal* will present an article by T. H. Risk, of Ethyl Corporation's Technical Service Department, which will cast light, with little heat, on the whole subject.

Simplified Flying Chart Will Hold Plane on Beam Of Maximum Fuel Economy

LONG-DISTANCE air transportation, now changing from pre-war dream into post-war engineering project, already is creating problems which the war period is affording time to solve. Among them is fuel economy, which contributes to the difference between red and black on balance sheets, and promises to be a pertinent factor when competition again enlivens the airways.

Development of airplane power control methods has facilitated the application of ways and means of governing fuel consumption. Maximum, and even extreme, fuel economy now is possible. By balancing the characteristics of ship, wing, and engine and propeller, the pilot of a properly designed plane can get on the beam of fuel economy and produce maximum ground miles per gallon.

May *SAE Journal* will present an article by Frank B. Lary, of Wright Aeronautical Corp., on this subject. He will discuss analysis and control of long-range cruising which, by definition, means obtaining maximum ground miles per gallon of fuel.

Army "Duck" Heralds Vehicular Progress

Global use of all-welded "Duck" by U. S. Army in severest service is developing experience data which will accelerate design and production of peacetime all-welded transportation equipment, machines, and structures. (See "Copperation for Security in Wartime Producing Mutual Benefits for Peace," p. 11)

Navy Dieselization Program Primed for Additional "Engineering Impossibilities"

BACK of news of naval operations in World War II is the amazing story of diesel-engine progress, well worth reading for current interest, future implications, and thrills.

Current interest may be measured by Navy dieselization to the extent of more than 12,000,000 hp driving everything that floats from tugboats to battlewagons as against a meager 150,000 hp pushing a few submarines at the end of World War I.

Future implications aplenty are to be found in highly satisfactory wartime experience with multiple diesels and indirect drives in Navy ships operated by farm-boy crews thousands of miles from home ports under extreme service conditions.

The thrills are offered by engineering opportunities to solve a few technical problems, break a number of production bottlenecks, and find the key to a new powerplant.

This story, expertly spun in the best tradition of nautical yarns, yet savored with engineering substantiation, will be told in May *SAE Journal* by Capt. Lisle F. Small, of the U. S. Navy's Bureau of Ships. He writes authoritatively, as director of the Bureau's Internal Combustion Engine Section ever since Vice-Admiral S. M. Robinson in 1932 simultaneously wangled an appropriation from Congress, convinced the Navy it needed a high-speed diesel, and talked a worried diesel industry out of depression doldrums and into essential research.

Capt. Small will describe how the Navy has cut the knots of engineering controversies to employ both two- and four-cycle diesels and to apply as many as 40 pistons to the tough job of swinging propellers. Much, once cataloged as impossible, or inadvisable, has been and is being done, he will say, listing among the "engineering impossibilities" already accomplished such undertakings as use of multiple engine geared drives, welded steel construction, and mass production.

WRIGHT MEDALLIST DEVELOPS FORMULAS FOR MEASURING RELATIVE STABILITY OF PLANES

WIND tunnel tests have facilitated the development of formulas by which the relative stability of new aircraft may be ascertained and their tendencies to roll, yaw, or pitch measured with accuracy.

The formulas are based upon the concept of additional apparent mass, or the field of energy which a body in motion creates about itself and which is governed by its shape, it will be explained in May *SAE Journal* by C. E. Pappas, of Republic Aviation Corp. Mr. Pappas' technical treatise, "The Determination of Fuselage Moments," has won for him the SAE Wright Brothers Medal, annually awarded for the best SAE meeting paper on aerodynamics, structural theory, aircraft design, or construction.

Mr. Pappas will say that since the size, momentum, and kinetic energy both of the longitudinal and transverse additional apparent mass are measurable, it is possible to establish theoretical coefficients and to indicate the changes in these coefficients when boundary layer, interference, and turbulence effects are considered.

The data will be described as applying to radial and liquid-cooled engine installations, and as adapted to determining the pitching and yawing moments of engine nacelles on multi-engine planes. While data do not allow for canopies, gun turrets, underslung ducts, and other features of military planes, Mr. Pappas will suggest that the resulting changes in yawing or pitching moments may be approximated, or written off as negligible.

■ ■ ■

Port Dimensions Affect Aircraft-Engine Design

AREA of temptation to let well enough alone surrounds the inlet and exhaust ports of aircraft engines. Any revision of port dimensions necessitates cylinder-head modification, which is in the nature of a major change.

Selection of proper port dimensions, however, is a factor affecting performance requirements and durability, it will be explained in May *SAE Journal* by Vincent C. Young, chief engineer, Wilcox-Rich Division, Eaton Manufacturing Co.

Mr. Young will suggest as an immediate engineering need the establishing of some basic constant to simplify the problem of determining proper dimensions.

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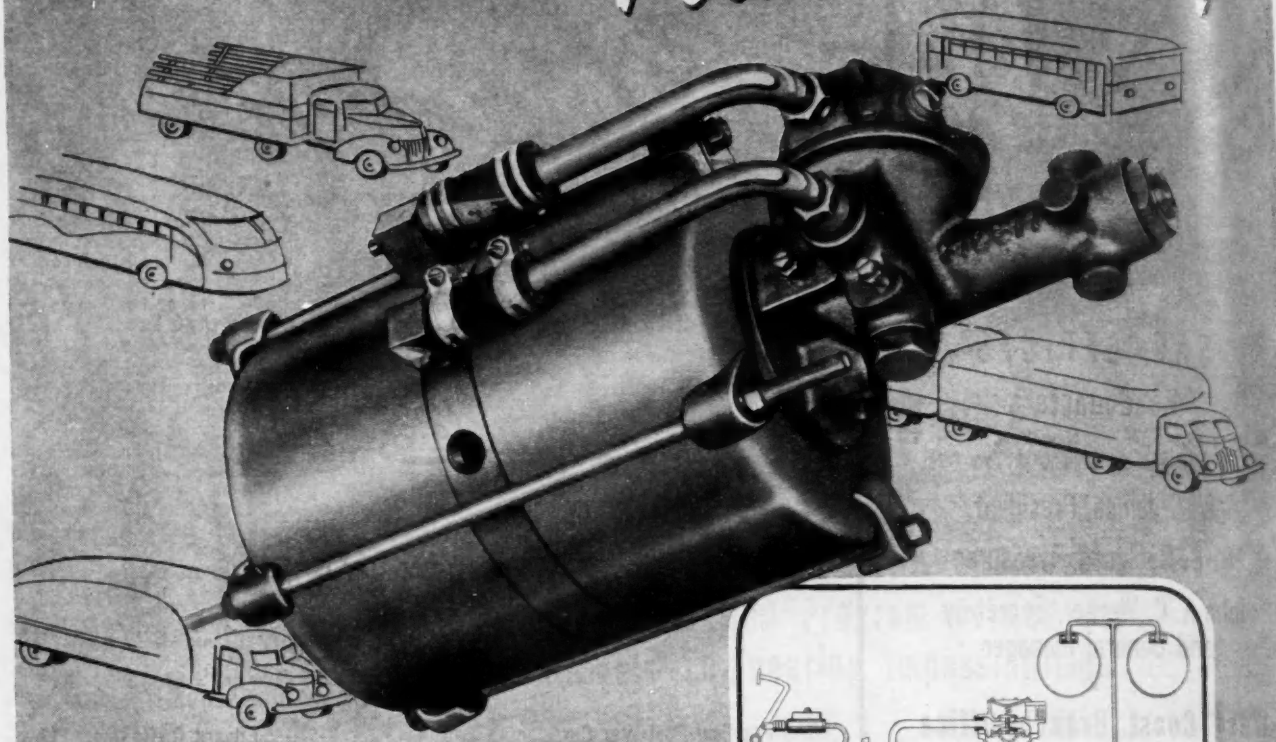
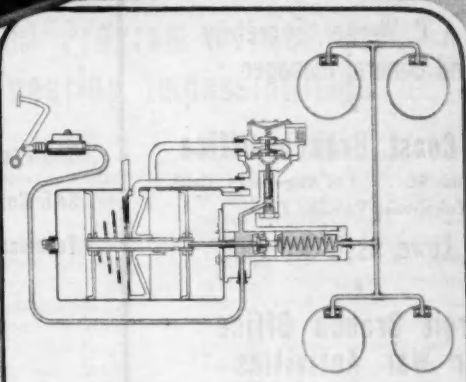
FOR SIMPLER *Power Braking*



HYDROVAC*



Physical effort on the brake pedal hydraulically actuates the valve which controls the vacuum power cylinder. The power cylinder acts upon the Hydrovac hydraulic cylinder, providing ample hydraulic power for full brake application.

- **Simplified Installation**
- **No external levers or moving parts**
- **Can be located practically anywhere on vehicle**
- **The ideal combination of physical control and power braking**
- **Safer — physical actuation is unimpaired in the event the power system fails due to accidental damage**

The "One-Unit" System OFFERS MANY OUTSTANDING ADVANTAGES

The Hydrovac Vacuum Power Braking unit combines into *one* compact assembly a hydraulically actuated vacuum control valve, a tandem-piston power cylinder and a hydraulic cylinder. This simpler system brings a new standard of safety to heavy hauling and offers unequalled ease of installation either as original equipment or as a replacement. It is but one of many Bendix peacetime products which are being further improved while serving on military vehicles and which will be available for civilian transportation when peace is won.

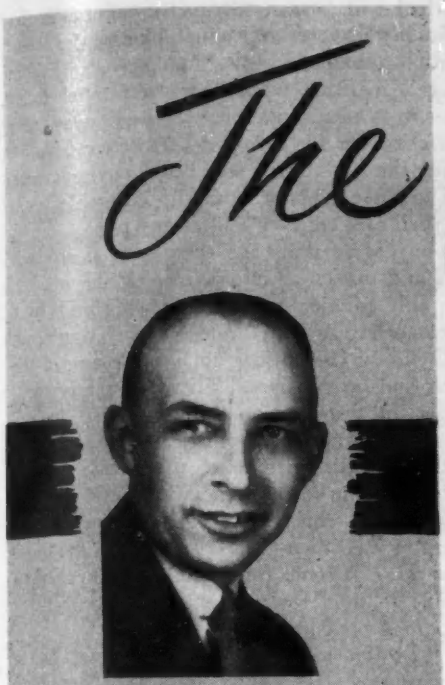
**Trademark of Bendix Aviation Corporation*

THE INVISIBLE CREW — Precision Equipment by Bendix Aviation Corporation

BENDIX PRODUCTS DIVISION OF BENDIX AVIATION CORPORATION • SOUTH BEND, INDIANA

The Practical Post-War Car

by Edgard C. DeSmet
Executive Engineer
Willys-Overland Motors, Inc.



IN this thought-provoking article, Mr. DeSmet points out the engineering probabilities of our early post-war cars . . . tells how economic realities will force designers to produce vehicles from proved materials . . . explains why engineering, economics and other eventualities will have strong influence of after-the-war car constructions.

The most spectacular revelations about "The World of Tomorrow," he shows, are coming from stylists through magazine and newspaper articles; statements by manufacturers themselves have been remarkably sober and practical.

Then he analyzes feature by feature and material by material the realistic possibilities and opportunities for improvement which exist in the years immediately following resumption of passenger car production.

(This article is an abridged version of the paper presented by Mr. DeSmet at the SAE War Engineering-Annual Meeting in Detroit on Jan. 10, 1944. The complete paper may be obtained by writing to the *SAE Journal.*)

DURING prolonged periods of national emergency such as created by a major war, many new discoveries are made in constructive as well as in destructive fields. We find, however, that the discoveries of mankind can be put to use in many different channels and that they can all be made to contribute ultimately to the welfare, progress, and happiness of humanity.

It is, therefore, safe to say that many new products and many new processes will be offered for public consumption after the war and that some of these will be of such magnitude that they will materially affect our everyday way of living.

Due to the restrictions of military censorship the public has only been partially informed regarding the nature and advantages of these new products. In some rare instances the announcements are being made by the manufacturers themselves; and it is to be noted that their statements are remarkably sober and practical, for they have no doubt, been carefully weighed and analyzed before release.

On the contrary, the most frequent and most spectacular revelations about the "World of Tomorrow" or about "The Shape of Things to Come," are being made by our so-called "industrial designers and stylists" through the medium of national newspapers or magazine articles.

In keeping with the designers' activities in the automotive industry during the pre-war days, it is indeed significant that the great majority of these proposed post-war miracles will be applicable to the transportation industry. Indeed, more has been written about the post-war automobile than about all the other types of products and appliances together.

A typical article on the post-war automobile invariably includes one or more illustrations of a superstreamlined vehicle, a cross between an oversized beetle and a traveling show case, the product of the artist's fertile brain and of his versatile and carefree airbrush, which is supposed to carry the reader's imagination beyond the physical realm of earthly things. Even though the writer may have buried somewhere in his article some cautious statement regarding the age or period in which his creation may actually come to pass, the designs and illustrations of the ultimate car are inevitably displayed most prominently, thus leaving their permanent mark on the minds of the casual readers and passersby, who are unquestionably in the greatest majority.

The name of the writer is most always prominently displayed along with a list of his other accomplishments so that the entire article resolves

itself to a self-advertisement by the stylist rather than an announcement and description of a new product.

The obvious reason is that the stylist has no actual physical product to sell. He merely sells talismans and magic carpets in the form of beautiful pictures at fanciful prices. He has a remarkable dislike for details of construction, a definite aversion to production problems, and a superb contempt for anything pertaining to money or cost, with the obvious exception of his own fee "for services rendered."

The creator of a new product is not the wishful thinker nor the waver of the magic wand. If an artist painted a picture showing a bouquet of blue and green roses, he would, no doubt, show great originality, but the fact that he thought about blue roses before anyone else did does not make him a great floriculturist unless he can follow up his idea and produce such a flower in real life. We would not want to go on record and state that Leonardo da Vinci invented the helicopter, nor that Jules Verne originated the submarine, even though they left definite evidence of preliminary conception of such devices. If we think that way, we may as well get ready now and prepare a special niche in the Hall of Fame for the creators of Flash Gordon and Superman.

■ Scientists Real Creators

The real creators are the scientists who, by tedious experimentation and research, discover how to harness the forces of nature and how to convert our basic elements into commercial products. Once the product is found and its properties are established in the laboratory, the list of applications and uses becomes perfectly obvious and industry does the rest.

Still, it must be said that the designer, as a member of the research organization, performs a definitely useful function. He stirs the imagination and introduces new lines of thought. It is, therefore, true that many manufacturers have a number of designers on their own staff and the products of that department in the form of sketches and color drawings are substantially the same as those offered to the trade by the independent stylists.

The important point is, however, that those drawings are not glorified nor publicized; they are not being peddled to the management nor to the nontechnical members of the board; they are not being published in newspapers and magazines with glowing promises to the public of a mythical product to be sold at ridiculously low cost, and offering many miraculous features and fairy tale performance.

On the contrary, when the time comes for surveying the work of the art department, the most promising drawings are carefully sifted out by the engineers and they are returned once more to the artists for revision and for toning down to practical lines, within commercial possibilities, with the inevitable result that the final creation instead of being a total stranger from a new world looked upon with awe and mystery, now appears very much more familiar and will in reality be much more wholesome and more inviting to the prospective purchasers and users of the automobile.

It is for that reason that engineers are sometimes denounced as narrow-minded ultraconservatives, entirely devoid of vision and progressiveness, while the manufacturers are also being accused of retarding progress by holding back the production of allegedly fully developed innovations and improvements.

It is a known fact that it is quite easy to design and build a car which will attract so much attention that it will stop traffic on the street and will capitalize the attention of the entire automobile show. But it is also known that the average American, while being very much interested in discussing a new sensation, will back away from it and will purchase for his own use a more conservative car, thus leaving the risks of the so-called first-year experimental period to his neighbors, with the inevitable result that very few such cars are ever sold at any price.

Statistics show that 20 years ago there were nearly 200 different kinds and makes of automobiles on the market. Today we can only enumerate 19 makes being built by 9 different manufacturers and it is indeed a very significant fact that the list of survivors does not include any of the so-called leaders and progressives. They apparently spent all their energies and resources on costly overhead, including designing, engineering, and tooling, but were not able to overcome the cautious attitude of the public and its aversion toward anything radically new whenever its own personal pocketbook is concerned. They witnessed the adoption of most of their own pioneered ideas by the more conservative concerns at some future time, but even then were they unable to hold their own against competitive advertising and high-pressure salesmanship.

This brings us right to the very fundamental factor which will govern post-war industry just as it governed pre-war activities and as it will definitely continue to govern production of goods and materials for all time to come. That factor is *cost*.

The day after Victory Day will mark the return to peace but will also mark the return to private competitive business and enterprise. Regardless of the average citizen's social or financial status, cost will still be the predominant factor in the development of any successful product.

The automobile manufacturers are basically not producers but users of goods. With very few exceptions they do not make steel, aluminum, glass, plastics, fabrics, or paint. They merely select from the list of materials which are being made available to them by the basic producers. This selection is naturally based on the various properties of the materials as offered and also on their respective cost. No material will be used in large-quantity production unless it be fully certified by its producer and unless its cost be made comparable to other materials performing similar functions.

■ Public Desires Dominant

The American public will not pay excessive premiums for intangible features and questionable improvements. Neither will it be willing to sacrifice practicability, safety, and fundamental habits and standards for the sake of fulfilling the predictions of untimely prophets.

Enough has been said regarding what will constitute the imaginary post-war automobile. We have chosen as the subject of this paper a sober discussion of the practical post-war car, in direct contrast with current fantastic predictions. We will not try to tell you any more about what the post-war automobile will be like, but will instead confine our remarks to what type of car cannot, in our opinion, be made acceptable to the motorist nor can be economically produced by the manufacturer.

We will examine the status of major allied industries and analyze various available materials from the stand-

point of adaptability to large-quantity automobile production on a competitive basis.

We will confine our survey to those basic materials entering into body construction, which have figured most prominently in post-war predictions.

■ Aluminum Body

As a basic material, we find that the cost of any suitable aluminum alloy is much higher than body steel. Present sheet prices call for an average of 30c per lb for aluminum, against 3c per lb for steel, or about 10 to 1. Considering an approximate saving in weight of one pound for each pound of aluminum used, when comparing parts of equal strength, we still have an unfavorable cost ratio of 5 to 1 for a given fabricated assembly. Undoubtedly, the price of aluminum will be lower after the war due to the tremendous expansion of manufacturing facilities, but it must be remembered that production of steel has also increased considerably and that no matter what happens, steel as a raw material will always be far cheaper than aluminum. Even if we adopt secondary aluminum for the majority of our body parts and are able to realize thus a total reduction of 50% in the present cost of aluminum, and if we discount the possibility of any reduction in the price of steel, the final cost ratio for a given assembly would still be 2½ to 1 in favor of steel.

It should be understood that this penalty is taken directly on the raw material as we would purchase it before any fabrication or assembly. When considering these additional operations, we will find that such penalty is considerably increased due to several factors which all tend to reduce the output of aluminum parts in comparison with the normal production of steel stampings.

Aluminum alloys cannot be formed and drawn to the same degree as steel, and their adoption would require a major revision in design of the bodies as at present developed for steel construction. Curves and contours would have to be minimized and the depth of the draws reduced to conform with the physical limitations of the aluminum.

Parts would also have to be simplified by the elimination of sharp corners and of integral complex flanges. This would necessarily reinstate a great number of minor individual parts, such as small brackets and reinforcements, which had been gradually eliminated, by combination, on steel bodies but which would now resuscitate former subassembly problems and labor costs.

While it may be possible to fabricate a set of body panels and parts generally similar to present design standards by using some of the newer aluminum alloys, the additional operations in the drawing process, plus necessary annealing and heat-treat, would reduce the output to such an extent as to make them entirely impractical for large-quantity production and definitely out of line for competitive marketing.

The modern steel body is assembled almost entirely by spot welding. The application of this highly efficient procedure to aluminum brings in a lot of new factors:

Aluminum spot welding is much slower and a lot more exacting. The shape of the electrodes, the intensity of the welding current, the pressure and timing of the mechanisms holding the parts while being welded, must all be held to more accurate limitations and demand a much higher degree of control.

If aluminum bodies are adopted, the service man will have to acquire an entirely new technique and new equipment will also be required. In most cases, repairs will be quite impossible and new parts will have to be installed, thereby increasing the service cost to the car owner far beyond present standards.

In view of the above, it seems that, in the event we decide that the saving in weight is of primary importance and that the basic cost penalty of aluminum over steel is not objectionable, we would find that from a practical manufacturing standpoint, we could best take advantage of such substitution by adopting aluminum, not for the body and sheet-metal parts, but for chassis parts such as castings, forgings, and chassis members, where the weight concentration is greatest and fabrication methods would not be materially affected by the change in material.

Considering now the plywood body:

The development of plywood structures for major aircraft units and subassemblies has attracted a great deal of well-deserved attention.

At present, many of the leading manufacturers of wood products are fabricated plywood structures for the aircraft industry. They are producing major subassemblies such as wings, fuselages, and tail surfaces, for modern training and combat planes, following rigid Government specifications and designs.

The various laminated wood parts and assemblies cover a very wide dimensional range, depending upon their respective functions and stress requirements. Single sheet sizes are almost unlimited, running as high as 50 ft and more. Individual thicknesses vary from 0.015 to ⅛ in. and these are used to build up the laminated assemblies to an overall thickness varying from 1/16 to 6 in. and more. The variety of usable kinds of lumber includes spruce, birch, mahogany, poplar, and walnut. Balsam and fir are also used for nonlaminated parts such as fillers and stringers.

In all cases, a plastic resin glue is used; in fact, the recent development of such truly remarkable bonding medium, totally impervious to moisture and decay, is chiefly responsible for the rebirth of laminated wood as an acceptable material for aircraft construction.

■ Lamination Process Old

The lamination process itself conforms fundamentally to age-old practice. Various layers or plies are coated with glue on all contacting sides, generally by spraying or by passing them through rollers; they are piled up or "stacked" with the grains running in alternate directions. The stacks are then placed in presses between heated forms, with suitable pressure provided to hold the laminations to the desired shape during the gluing process. Pressures vary from 50 to 250 psi and the drying or curing cycle requires from 1½ to 50 min or more, depending upon the thickness of the laminated assemblies and the intensity and type of heat used for drying.

The air throughout the plant is kept at very high humidity at all times to prevent cracking and splitting of individual plies in handling, stacking, and fabrication.

The one outstanding fact, which is also the greatest limiting factor in the fabrication of formed plywood parts, is that so far no one has yet been able to "stretch" wood. This means that practical forming, using uniform sheets for the plies, is confined to single-curvature surfaces often called "wrapped" surfaces, thus limiting designers as well as manufacturers to very simple formations and shapes.

However, more complicated parts can be made by following a much more intricate process requiring the building up of individual diagonal cross plies onto or into predetermined male or female forms. In this procedure, each layer is composed of a great number of narrow strips or lattices supplemented by hand-trimmed and hand-fitted wedge-shaped fillers. This requires very great skill on the part of the operator and demands much more time for loading the form, all of which items are, of course, reflected in a tremendously increased cost.

For parts requiring a very smooth finish, a special cotton fabric is used for the outer ply, thereby covering up the numerous joints and irregularities in the surface and incidentally contributing further to the quality and strength of the finished panel.

■ Plywood Advances

The advances made in plywood construction as outlined above, are without doubt, most outstanding, thanks to the development of the new bonding medium, which eliminates all screws and nails from the entire assembly. When comparing this type of construction to standard aluminum-alloy aircraft designs, there is no question that the plywood design is far simpler and makes possible great savings in critical materials, man-hours, and cost. This is, of course, due to extreme complication of metal aircraft construction which has never been designed for high-quantity production.

If, on the other hand, we attempt to make a similar comparison between plywood construction and modern automobile design, we find that plywood is at a very distinct disadvantage in man-hours and cost. Automobile body structural design has been refined to such a point where a minimum number of individual stampings are necessary to make a complete assembly. Plant equipment makes it possible to fabricate those individual stampings at far greater speed than is possible with wood laminations; also, in ordinary times, the steel itself will be much easier to get, and at far lower cost, than the various types of wood required for adequate fabrication.

If plywood construction were used on automobiles, we would have to abide by the severe limitations pointed out in the previous paragraphs. This means first of all, that our designers would have to confine themselves to much simpler shapes and surfaces. Serious problems would also be connected with the assembly of the various units of the body to each other as well as to the auxiliary parts, and also the mounting of those units to the main chassis structure.

The question of service and repairs in the field on plywood bodies and parts would be even more complicated than most of us realize. In fact, no reasonable suggestion has been advanced so far by any one in the industry. A new technique and all new equipment would have to be developed. Dealers and service stations would have to train new personnel, and it is very questionable that even with the best of help and equipment, any complex surfaces such as are found on automobiles may be patched anywhere near satisfaction.

At any rate, the cost of such repairs would be extremely high and the owner's car would be tied up for far greater periods than are now required for adequate servicing of sheet-steel bodies and parts.

In regard to the plastic body:

No other term has been abused quite as much as the word "plastics."

When this new industry became of age and it became quite obvious that plastics were to assume a permanent function in our everyday way of living, the designers lost no time in capitalizing on the public-appeal possibilities of this new magic material.

The average human mind has a distinct aversion to anything it does not understand; it prefers simplicity and generalities, and here at last was a product whose properties supplied all the answers. Indeed, we were told that this material could be made out of almost anything from beans to coal, or from any surplus stock we may happen to have lying around; that it could be molded to any shape, in any finish, in any color, and presumably to any size; and that it could be made to replace metal, wood, rubber, glass, and even fabrics. In fact, there seemed to be no reason why everything from fountain pens to bombers could not be made out of plastics.

Since the parts were to be made in molds and since the material itself seemed to possess the combined properties and advantages of all other substances, it seemed logical to say that it must be possible to combine all the old component parts into one single mass and thus make the plastic replicas in one piece, by one simple operation.

Such is the line of reasoning which has been fostered and kindled by the irresponsible press agents, and it is only natural that the automobile be chosen as the major subject for such fantastic predictions. What could, indeed, be simpler than a plastic automobile body in one piece with fenders and all, created in a matter of seconds and coming out of its mold practically all ready for the road.

The fact is, that the one-piece all-plastic automobile body is definitely out of the question, since it has been established that the production of pure homogeneous masses of plastic material is only acceptable, when confined to comparatively small, nonfunctional and nonstressed parts.

■ Properties of Plastics

In looking over the numerous varieties of plastics developed so far, we find that, as a whole, they all have many remarkable individual properties, but also many distinct shortcomings, and that so far no one plastic has yet been developed which possesses all the qualities and none of the faults. The most common disadvantages are: brittleness, distortion under various atmospheric conditions, and excessive cost; and these factors are the ones directly responsible for the dimensional limitations imposed upon homogeneous plastic parts in industry.

We do know, however, that the manufacturing of larger parts has been under serious consideration for some time by the plastic industry and that a great deal of progress has been made along those lines.

In such cases, a filler has been used in combination with a plastic bonding medium or binder. The filler serves a double purpose by reducing the amount of plastic material required and thereby lowering the cost, and also by contributing very substantially to strength of finished parts.

Various substances, such as ground wood, chopped fibers, paper, woven fabric, or plywood, may be used as fillers depending upon the requirements. When a ground filler is used, such as chopped wood or textile fibers, the filler is mixed with the plastic and molded as one compound, and an additional layer of plastic is added on the outside surfaces to provide the finish coating.

When the filler is in the form of a sheet, such as paper, fabric, or plywood, the assembly must be laminated either in large flat sheets or in latticed layers, and the entire process is identical to the one previously described for plywood structures. In fact, it has been found that for maximum efficiency at lowest cost, plywood as a filler was best suited for all around purposes.

At present, the chances for manufacturing, on a production basis, entire automobile bodies of laminated plastics of any kind are still very remote.

Curved windshields and side lights:

A definite design characteristic of the much publicized futuristic car is the display of a wide expanse of curved transparent material to take the place of the conventional door and window glasses and also a bulbous bay-window-type windshield extending in one piece all around and over the driver and the front-seat passengers. Some times this transparent material is extended into the top and it has even been suggested that the entire upper structure of the car could be made of one single piece of shaped glass or transparent plastic material.

Let us first consider the possibilities of curved glass:

It has been established by the glass manufacturers that flat plate glass provides maximum clarity of image and freedom from distortion, and any departure from a flat surface results in reduction of important optical properties.

When an object is viewed through curved glass, a distortion is produced because the front and back surfaces of the glass are not parallel at the points where light rays enter and emerge from the glass. The shift of visual rays and resultant displacement of the image is proportional to the distance between the glass and the object; it also increases as the angle of incidence becomes greater.

In night driving, all points of concentrated light, such as street lights and headlights of approaching cars, when viewed through a sheet of formed glass, appear in multiple sets, each light resulting in two, three, and sometimes more subsidiary reflected images of graduated intensity, which seem to travel upon the curved surface along distorted paths, as the car approaches the original sources of illumination. Curved glass has also been found to be astigmatic, depending again upon the amount of curvature and the angle of incidence of the visual rays.

Since the human eye automatically compensates for these defects and since the amount of compensation required varies continually as one looks through different areas of the curved glass, the inevitable effect on the passengers is a distinct feeling of eye strain and fatigue, which is of course most apparent at night.

Experiments have shown that a glass having a 60-in. uniform bending radius and mounted at an agle of 45 deg, represents the extreme condition which is acceptable for commercial use in automobile windshields and side lights. The curvature must be uniform, of cylindrical shape, and with the axis of the cylinder in a vertical position.

Any deviation from these limitations, such as excessive angularity, smaller bending radii, compound curvatures, or even cylindrical bends about a horizontal axis, will emphasize the optical defects and physical disadvantages of the glass and will make the car so equipped entirely unfit for comfortable and safe operation on the highway.

In regard to clear plastic enclosures:

First of all, the optical qualities of clear plastic materials are far inferior to those of plate glass. It has indeed been recognized that the best flat sheet of transparent plastic that can be molded on a commercial basis, is optically worse than the cheapest kind of window glass. When molded into curved shapes, the optical conditions become impossible, and all that has been said about the unfavorable properties of curved glass can be repeated on a magnified scale for curved plastics.

Another major shortcoming of the clear plastics is their low factor of surface hardness in comparison with glass; they are subject to abrasion and surface scratches even under normal conditions. The simple operation of wiping off road dust with an ordinary cloth, or the action of the windshield wiper operating over the usual amount of dust deposited on the car or in suspension in rain water, will leave very definite marks which will multiply from day to day, until the material has lost most of its transparency. In night driving, each one of these numerous hair scratches creates its own individual refraction problems, with the result that every one of the points of concentrated light and their subsidiary reflections now appear to have halos and look like so many moons in a foggy sky. If the condition becomes extreme, the halos expand and overlap until they cover the entire surface and the material must be replaced for lack of visibility.

We have been told that surface scratches can be removed from plastic materials and that the transparency of the material can be restored successfully by buffing and polishing. This can indeed be done if the scratches are not too numerous nor too deep, but it must be remembered that the buffing operation which obliterates the scratch does so by removing some of the material adjacent to the scratch, thereby creating a new surface cavity, resulting in more-pronounced visual distortions in that area, and this new defect is just as bad or worse than the scratch itself.

From a structural standpoint, we know that the all-curved plastic upper-structures and enclosures, while being shatterproof, would not be any stronger than glass of similar shape, and far less dependable in case of accident than the conventional steel and flat glass combination.

From a cost angle, we may state as a basic comparison, that at present a sheet of clear plastics, whether flat or curved, costs about twice as much as a corresponding amount of laminated safety plate glass of similar shape. Though we may anticipate a substantial price reduction of plastics after the war, we feel sure that glass will, for many years to come, retain its place in the industry as the most economical, efficient, and practical material for the fabrication of automobile windshields and standard enclosures.

The last point to be considered is the general design and architecture of the car:

The radical designs which are being submitted as post-war cars show us that the front seat is to be moved still farther ahead than it was on the latest pre-war models. The front passengers will have to sit at least partly between the front wheels and in some instances directly above the front axle. In so doing, we will have to deny these front-seat passengers all previous considerations because, according to present standards, they will not only have lost all riding comfort, but will also have been deprived of a convenient means for entering and leaving the car.

The position of the front wheels prevents the door from being moved forward along with the seat, so that the front-seat passengers will no longer be able to slide in and out of their seat as they did in the past. In fact, there will be no way for the front passengers to get to their

seats without being forced to take several steps inside the car. This will not be an easy matter, for when we consider the abbreviated headroom being provided in all modern cars, this walk will be more like a crawl, and will certainly not be enjoyed by prospective buyers of the new cars.

We know that on some vehicles such as trucks, buses, transport planes, and even on one make of automobile, the driver's seat has been placed away from the door, but, in each case, adequate headroom has been provided to permit the passengers entering or leaving the vehicle, to walk nearly in an upright position. The expert post-war designers are definitely not making allowances for such headroom requirements.

Aside from the question of headroom, it would also be necessary to provide some means of access to the front seat, either by a center aisle located between individually divided seats, or by a clear passageway on either side. Many of the publicized sketches show a three- or even a four-passenger front seat without any passageway whatever and we are at a loss to visualize how the passengers can possibly be expected to get to their seats. Even if we concede that they would be willing to climb over the backs of the unoccupied seats when folded down, we wonder how the last passenger would manage to get in at all, and it would certainly be even more interesting to see a demonstration in reverse showing what kind of a contortionist's trick would have to be performed, by the first one desiring to leave such a crowded compartment.

Some designers have recognized this problem, and have confined the capacity of the front seat to two passengers with a center aisle. Others show a single driver's seat located in the center of the job. However, any such variation reduces the passenger-carrying capacity of the vehicle, unless a third seat is provided in the rear, and, in this case, we would find that it would be necessary to lengthen the car beyond all practical limitations of wheelbase, overall length, weight, and cost.

The extreme forward position of the front-seat passengers presents another very serious mechanical problem, namely, the overall width of the car.

At present, with a conventional 56-in. front-axle tread and 27-in. O.D. tires, the clearance between the front wheels when fully cramped, is approximately 32 in.; this is not enough for two passengers and could only accommodate a single seat with access passageway. When the front wheels are fully covered up with bumpers all around as shown on most of the proposed designs, the overall width of such a car becomes about 86-in., which is about 16-in. wider than the average conventional pre-war job.

Now if we decided to preserve our present three-passenger front seat and move it between the front wheels, we would have to adopt a front-axle tread of 82 in. and an overall fender width of 94 in. with exposed wheels or about 110 in. (a little over 9 ft) with wheel covers. The tragic side of this picture is that if we were induced to buy such a car and drove it home, we could not pass any other car of similar size on the average city street with safety, and if we did manage to reach home, we could not get the car in our garage due to its excessive width.

Ever since the first sketch of the "teardrop" car was made, about 15 years ago, we have heard a lot about moving the engine to the rear. This again is a feature which has been advocated by the stylists for no good reason at all, except that it fits into the "teardrop" silhouette. The possibilities of this proposal have been thoroughly investigated by the majority of the automobile manufacturers, but so far no sound functional argument in favor of such rearrangement has been advanced by any of the technicians.

In reality, the only practical reason we may possibly have for moving the engine to the rear of the car, would be to move the passengers all the way forward and we already know all about that.

Even if we find some practical answers to the previously outlined complications arising from such a design, we would also have to give serious consideration to an important psychological problem, before such a car could be offered to the public. It would, indeed, be interesting to know what the average motorist's mental reaction would be if and when he takes out the new car for a trial run and finds himself sitting right out in front going 80-90 mph, with 95% of the weight of the car behind him, and no apparent forward protection other than a front bumper and a glass or plastic bay window.

Only a few years ago, we would not have dared to offer to the motorist a car which did not have both front fenders in full view of the driver. This was a very sensible provision, but in those days the designers dictated longer and higher hoods, and regardless of the fact that they represented a definite waste in material, an actual reduction in engine accessibility and a serious restriction to vision and safety, we all ended up by driving cars with the engine compartment large enough to accommodate three powerplants, but which on the surface satisfied our ego for the possession of large, powerful-looking automobiles.

We have grown attached to long high cowls and hoods; they give us a feeling of importance and immunity. Though they restrict our vision, we have gradually learned to operate our automobiles with comparative safety.

There is no question in anyone's mind but that it would be equally possible, by a similar process of evolution, gradually to move the passengers to the front of the car, and to get the driver accustomed to that new position; but, contrary to the designer's predictions, we feel that if this is done at all, the transition will have to be very cautious and very slow, and that it will take the concerted efforts of all the sales departments of the entire industry over a great many years, gradually to lead the public into universal acceptance of such an automobile.

We believe that it is unfair and unwise to lead the public into believing that the day after Victory Day or very soon thereafter, they can be assured of entirely new products, possessing miraculous features, at ridiculously low prices.

We may find that a consumer's mind which has been misled by such unsound predictions may show a definite reluctance toward the purchase of the immediate post-war products. If that occurs, and we all decide to wait for the fanciful magazine prophecies to reach our retail shelves and showrooms, we may look forward to a lengthy period of disorganization and confusion which may well develop into a national calamity.

We hope that our remarks may help to dispel some of these public hallucinations, and that they may induce our stylists and designers into tempering their individual ambitions and bending all their efforts toward the conception and development of the all-important, really practical consumer's goods. Only in this way will they be able to lend any appreciable assistance in the tremendous task of stabilizing our social and economic lives and guiding our beloved country through the many dangers and uncertainties of the post-war readjustment period.

SAE Coming Events

National Meetings

AERONAUTIC, April 5-7, Hotel New Yorker, New York
DIESEL-F&L, May 17-18, Knickerbocker Hotel, Chicago
WAR-MATERIEL, June 5-7, Book-Cadillac Hotel, Detroit
T&M, June 28-29, Bellevue-Stratford Hotel, Philadelphia
WEST COAST T&M, Aug. 24-25, Multnomah Hotel, Portland
TRACTOR, Sept. 13-15, Schroeder Hotel, Milwaukee
AIRCRAFT ENGRG. & PROD. & ENGINEERING DISPLAY, Oct. 5-7, Biltmore Hotel, Los Angeles
FUELS & LUBRICANTS, Nov. 9-10, Mayo Hotel, Tulsa
AIR CARGO, Dec. 4-6, Knickerbocker Hotel, Chicago

Baltimore – April 13

Engineers Club: dinner 6:30 p.m. What's Cooking? – Jean Y. Ray, supervisor, automotive equipment, Virginia Electric & Power Co.

Buffalo – April 12

Hotel Markeen; dinner 6:30 p.m. Packaging Machinery in War – E. G. Kuhn, vice-president, Consolidated Packaging Machinery Corp. The Manufacture of Industrial Chain – Humphrey F. Parker, chief engineer, Columbus McKinnon Chain Corp. Sound Film – Materials of War.

Canadian – April 20

Prince Edward Hotel, Windsor, Ont.; dinner 6:30 p.m. War As It Is Fought in the Near East – K. E. Stockeldach, technician, Ford Motor Co.

Chicago – April 11 and 18

April 11 – Knickerbocker Hotel, Chicago; dinner 6:45 p.m. Brake Design Trends – Bryan E. House, chief engineer, Military Brake Engineering, Bendix Products Division, Bendix Aviation Corp.

April 18 – Turner Hall, South Bend, Ind.; dinner 6:45 p.m. Brake Design Trends – Bryan E. House, chief engineer, Military Brake Engineering, Bendix Products Division, Bendix Aviation Corp.

Cleveland – April 10 and 22

April 10 – Cleveland Club; dinner 6:30 p.m. Speaker and subject to be announced.

April 22 – Annual Buffet Dinner Dance.

Detroit – April 3 and 24

April 3 – Rackham Educational Memorial; dinner 6:30 p.m. The Future of Synthetic Rubber (Quantity Production – Its Use – Present and Future) – F. B. Davis, chairman of the Board, U. S. Rubber Co.

April 24 – Commodore Perry Hotel, Toledo, Ohio; dinner 6:30 p.m. Facts About the Helicopter – Col. H. F. Gregory, Engineering Division, Wright Field. Illustrated with motion pictures.

Metropolitan – April 20 and May 4

April 20 – Pennsylvania Hotel, New York; meeting 7:30 p.m. Post-War Truck Design – Frank Hawes, Dairymen's League Cooperative Association.

May 4 – Pennsylvania Hotel, New York; meeting 7:30 p.m. Aircraft meeting.

Milwaukee – April 7

Milwaukee Athletic Club; dinner 6:30 p.m. Speaker and subject to be announced.

Muskegon Group – April 27

Occidental Hotel, Muskegon. Speaker and subject to be announced.

New England – April 3

Engineers Club, Boston; dinner 6:00 p.m. War's Impact on Post-War Fuels and Lubricants – William S. James, chief engineer, Studebaker Corp., and president, SAE. Powerplant Problems in Personal Airplanes – Carl T. Doman, vice-president, chief engineer, Aircooled Motors Corp. Guest – John A. C. Warner, secretary and general manager, SAE.

Northern California – April 11

Engineers Club, San Francisco; dinner 7:00 p.m. Modern Concepts of Motor Fuels – Grant M. Wheeler, research engineer, Tide Water Associated Oil Co.

Northwest – April 7

Gowman Hotel, Seattle; dinner 7:00 p.m. Gasoline Turbines and Turbo-Superchargers – C. R. Plum, General Electric Co. representative to Boeing Aircraft Co.

Oregon – Weekly Luncheons

Every Friday, 12:00 noon at Irelands, Lloyds Golf Course, Portland.

Peoria – April 24

Jefferson Hotel; dinner 6:30 p.m. International Transportation After the War – A. T. Colwell, vice-president, Thompson Products, Inc.

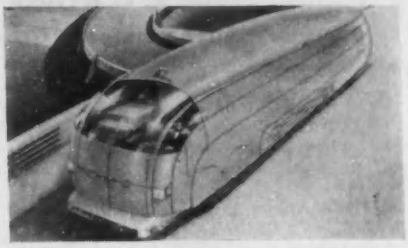
Philadelphia – April 12

Engineers Club; dinner 6:30 p.m. Subject – Lubricants. Speaker to be announced.

St. Louis – April 11

Forest Park Hotel; dinner 6:30 p.m. How Automotive Engines Are Rebuilt and Wartime Material Problems – Earl Faerber, chief inspector of engine rebuilding, Sterling Aluminum Products Co. Chrome Plating Cylinders for Decreased Wear – B. A. Yates, chief metallurgist, McQuay-Norris Manufacturing Co.

PITTSBURGH SECTION
FIFTEENTH ANNIVERSARY MEETING
April 25, 1944 • University Club



MORNING
C. R. Noll, Chairman

Tires
– K. D. Smith, B. F. Goodrich Rubber Co.
Aluminum – Its Alloys and Other Light Metals
– Dr. P. V. Faragher, Aluminum Co. of America

AFTERNOON
S. Johnson, Jr., Chairman

Fleet Operation
– S. G. Page, Equitable Auto Co.
Trucks
– B. B. Bachman, Autocar Co.

EVENING
Dinner * * Informal
A. J. Imblum, Chairman

T&M in the SAE
– W. S. James, president, SAE
SAE Participation in the War
– John A. C. Warner, secretary and general manager, SAE
Post-War Passenger Car Design – A Symposium
Experts: C. A. Chayne, Buick; Maurice Olley, British Ministry of Supply Mission; R. J. S. Pigott, Gulf Research & Development Co.; Max M. Roensch, Chrysler.
Harold F. Blanchard, sponsor
D. G. Roos, moderator

Southern California – April 14 and 28

April 14 – San Diego Hotel, San Diego. Aircraft Accessories Meeting.

April 28 – Hollywood Roosevelt, Los Angeles. Truck and Bus Meeting.

Southern New England – April 4

Hotel Bond, Hartford; dinner 6:30 p.m. Speaker – W. L. Batt, vice-chairman, War Production Board. Guest of honor – William S. James, chief engineer, Studebaker Corp., and president, SAE. John A. C. Warner, secretary and general manager, SAE.

Washington – April 10

Statler Hotel, Washington, D. C.; dinner 7:00 p.m. History and Development of Modern Torpedoes – E. M. Seifert, Naval Torpedo Station, Alexandria, Va. Motion Picture.

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Technical IDEAS

COLD STARTING

Is Tough Arctic Problem

by B. F. JONES and R. L. WEIDER
White Motor Co.

▪ Philadelphia, Nov. 10

(Excerpts from paper "Winterization of Military Combat, Transport, and Other-Purpose Vehicles")

WORKING on requests made through the Chief of Ordnance Office, the SAE War Engineering Board established first a Cold Starting Committee. Late in 1942, when the Ordnance Department established plans for a winter camp in Canada and asked W.E.B. to cooperate, the Cold Starting Committee was reorganized into the Cold Operations Committee, and this was subdivided into Steering and Camp Committees.

When we say a vehicle has been winterized, we mean a basic vehicle has been equipped, fitted and treated with certain aids which promote and produce the successful starting and operating of this vehicle in arctic climates. These aids have to be self-contained and self-operative, for there is no warm garage handy.

Must Be Simple

The aids have to be simple of operation, not visible from the air, not heard on the ground – since sound travels far in the arctic cold – and cause no interference with radio. They must be capable of application in kit form to vehicles already in the field as well as to vehicles coming off the production line. In addition, there is the problem of standardization with regard to service and parts. The ideal winter aid is one which will start operating with the close of a switch or a pull on a lever when the driver parks or bivouacs a vehicle, and which will stay in operation until such time as the vehicle is called upon to run again.

Cold starts were run until proof officers were satisfied that an aid functioned properly on the vehicle to which it was applied. Road tests followed, plus cross-country runs. Warm-up and cool-down tests checked heating characteristics. Traction tests were made with various type tracks and tires. Materials were given exposure tests. A lubrication cabinet mounted outside disclosed interesting data on various lubricating oils, fuels and greases. Antifreeze solutions were tested for their effects on cooling systems. Some specific results were:

1. Vehicles could be started in ambient temperatures down to −45 F when applied aids were properly used.

2. Electrical equipment gave no particular trouble.

3. Water, snow, and ice must be kept out of engine and heater fuel. All fuel must be filtered through chamois.

4. Natural rubber was best, Buna synthetics second. Tires made of these materials stand up well in cold weather. High flotation desert-type tires give superior traction.

5. Rubber tracks are superior to steel, giving better traction.

6. Brakes caused no serious problems. Alcohol systems proved to be unnecessary in the dry air on air-brake jobs.

7. More engines were ruined by towing to start than by low temperatures.

8. Oil pour points could be lowered by using pour point depressants, but still had to be agitated frequently.

9. Certain oils were more receptive to dilution, either by gasoline or fuel oil, creating doubt in some minds as to the efficacy of dilution as an aid.

10. Dilution tests provided inconclusive evidence whether dilution is harmful to engines. Engines that ran with dilution showed no trouble when torn down.

11. Ventilation tests gave no conclusive evidence.

12. High opening thermostats, 180 F, are best for winter operation. Winter fronts are necessary for good engine protection.

13. Provision for warming the driver's feet must be made in all vehicles. Air from a conventional hot water heater is satisfactory.

14. Electric defrosters should be hooked up through the ignition switch. They should be used on both right and left sides of the windshield, with frost shields on side windows.

15. Instrument panel controls should be designed for operation with boxing gloves – which are equivalent to gloves for arctic wear.

16. Winterized canvas was flexible and workable at −40 F.

17. Bourdon type gages have to be filled with gasoline and then plugged with grease at the end of the line, in some cases, to get successful operation.

18. Oil bath cleaners are run without oil.

19. Paints used on automotive equipment were found by panel tests to be satisfactory in subzero temperatures.

20. Plastic used in cab windows became brittle and unsatisfactory at low temperatures.

21. Illumination of instrument panels had to be improved so that it was possible to see them after looking across snow with the sun shining.

Protection of Operators

Operators also have to have sufficient protection. Woolen underclothing, goggles with dark lenses, and a fur hat or helmet with toque are essential.

(The paper originally written contained a great deal of data that cannot be published at this time due to censorship limitations.)

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Wartime Cargo Plane Suggests Commercial Possibilities

by D. L. MOSELEY
Douglas Aircraft Co.

▪ 1944 Annual Meeting

(Excerpts from a paper entitled "Production Design Changes of the C-47 Airplane")

THE object of this paper is to compare design changes on the C-47 with the DC-3 airplane. The C-47 was redesigned from the DC-3 to meet various military cargo requirements and to facilitate a higher rate of production.

Wing Fuel Tanks – DC-3 wing fuel tanks were of the conventional welded aluminum type. The C-47 fuel tanks are made in two halves and welded together by the carbon arc method. The upper half is made from 0.064 and the lower half from 0.072 3S-O aluminum. These sheets are drawn to a depth of 8 to 10 in. on the deep-draw press and at the same time a 90-deg flange is formed around the open side of the tank. These outstanding flanges are welded together in the joining process. All of the tank fittings are welded on, except the large outlet casting, which is bolted on.

Ring Joint in Fuselage – Originally, the tail end of the fuselage of the DC-3 and early C-47 was joined to the main fuselage

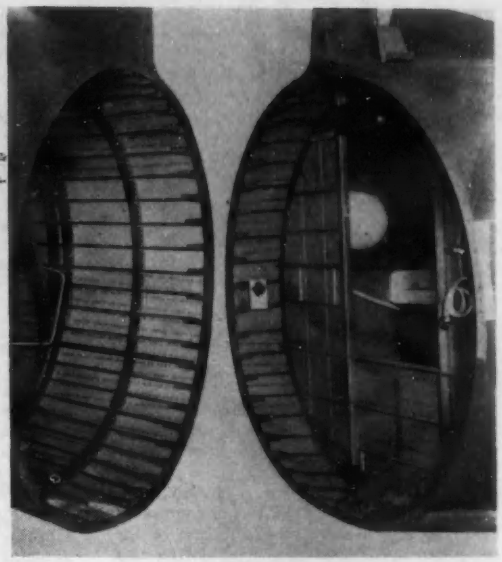
RETRIEVABLE

THE tactical military glider, a large aircraft weighing up to 18 tons fully loaded with a wing spread of from 80 to 120 ft, is a recent innovation used for invasion purposes. Its normal mission is to descend noiselessly behind the enemy's lines and unload its cargo of troops or tactical weapons. It was originally felt that such gliders would be abandoned upon completion of their mission; however, the "aerial pick-up" technique has changed that, and gliders can now be picked up by their tow-planes from fields altogether too small for the tow-plane to land on; thus they can be used again and equipment and troops can be displaced from one target to another. This leads up to their use for evacuation of casualties from small, obstacle-surrounded areas.

The design of these gliders makes them somewhat unsuitable for use as transport

Given at SAE MEETINGS ★ ★ ★

for ENGINEERS

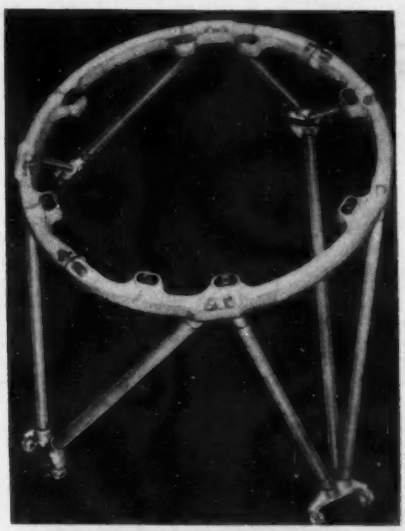


▪ Fig. 1 (right) – Fuselage ring joint

structure by riveting staggered sheets and stringers together. The C-47 has a fuselage ring joint, as shown in Fig. 1. The fuselage on each side of this joint has a built-in closing ring; the final connection being made on the production line with bolts. Bolt holes are drilled in the rings before they are installed in the fuselage. Although there was an increase in weight of 27 lb for the ring joint, it is believed the savings in production and field repair time are worth the added weight.

Fuselage Cargo Floor – Basically, the floor consists of corrugated aluminum-alloy sheet, supported from below by a series of beams running across the fuselage. The corrugations are 1¼ in. in depth and are made of 0.040 24S-T Alclad. Since the floor has to withstand the heavy wheel loads of an engine crate dolly or small field guns, two tracks are built into the floor running lengthwise of the cabin. These tracks consist of 0.064 24S-T Alclad flat strips attached to the tops of the corrugations by spot-welding. In regions of high local stresses, rivets are used instead of spot-welding. Fittings are built into the floor for litter and cargo tie-downs. The flooring is removable, since it is attached to the beams by screws.

Troop Benches – The C-47 troop benches are made in sections that seat from four to five men. The seat itself is merely a depression in the top of the bench; no cushions are provided. Each seat has a safety belt. When not in use, the benches can be folded back out of the way. The first benches were made of aluminum-alloy formed sheet. Later, in an effort to conserve strategic materials, they were made of plywood. The wood benches were slightly heavier than the metal ones, the total increase in weight being about 6 lb per airplane.



▪ Fig. 2 – Forged engine mount

Landing Gear Rear Brace Strut – The gas-welded tubular rear brace strut that was used on the main landing gear of the DC-3 has been redesigned into an assembly consisting of a tube and two forged halves for the C-47. This rear brace strut resembles a two-pronged pitchfork. The two forgings extend around the wheel to the axle, and a long flash-welded tube connects the forgings to the wing structure. The tube and forgings are held together by bolts. The small yoke forging on the end of the tube is attached by flash-welding.

Engine Mount – The DC-3 was equipped with the conventional welded steel tube engine mount. The C-47 engine mount has a forged steel ring and forged yoke fittings for attachment to the firewall bulkhead. (See Fig. 2.) Small steel fittings are flash-welded to the ends of the tubes, and the entire structure is assembled by means of tension bolts. The ring, which is made from either two or four forgings, is also held together by bolts.

Flash-Welding – Flash-welding is used extensively on the C-47. Many parts that

concluded on p. 26

GLIDER IS CHANGING AIR STRATEGY

by A. FRANCIS ARCIER
Waco Aircraft Co.

▪ **Southern Ohio, Jan. 10**

(Excerpts from paper entitled "The Glider, A Critical Appraisal")

vehicles in the commercial sense. They must have relatively low wing loading for low landing speed on well-nigh impossible terrain in the dark. They must be of simple construction and must make use of non-strategic substitute materials. They must be capable of disassembly into 24-ft sections for overseas shipment, with consequent weight penalty. They must submit to towing by practically every tactical airplane in the air forces. They must have parachute, emergency, and landing doors; a permanent landing gear for training and for certain missions, and a droppable landing gear and landing skids for other missions; they must be highly maneuverable, stable in tow, reasonably easy to fly, with a large speed range, and capable of landing on rough ground or water.

The design of a suitable tow-plane, which is of paramount importance, might involve the use of liquid-cooled engines to insure adequate cooling on an Army standard hot day in auto-lean at low-pressure altitudes in cruising and at necessarily higher horsepowers of low-speed climb. Such a design would require low power loading, medium wing loading, possibly contra-rotating engines, much greater engine cooling capacity, and reduced cooling horsepower requirements, large flaps, preferably of the area-increasing type, large stabilizers and large control surfaces and the possibility of a neutral-position tow attachment point.

The characteristics of a suitable transport glider, which has a distinct advantage in the air transport picture, particularly where the greatly increased flexibility of the "aerial pick-up" technique is employed, would include: a wing loading figure upward of 25 lb per sq ft, an area of 480 sq ft, an aspect ratio of about 10, a weight empty of about 40% of the gross weight, a payload of 6000 lb, retractable tricycle gear, large front or rear loading doors, considerable stability in tow, provision of automatic pilot, large flaps, and general aerodynamic cleanness.

For long hauls the best arrangement of glider train would probably consist of one glider for each tow plane. For short hauls, the multiple tow, with "aerial pick-up" would probably yield the best overall results as far as profitable operation is concerned.

were gas-welded on the DC-3 have now been designed to take advantage of the flash-welding process. Typical parts that are being flash-welded are: side members of the landing gear upper truss, landing gear rear brace strut, compensator rods, engine mount forged ring, and engine mount tubes. There are seven flash-welded members in the main landing gear assembly.

It is Douglas Co. standard practice to proof test all flash-welded primary structural units. Proof testing of flash-welds has been found to be more reliable than either magnetic or x-ray inspection, for the flash material causes the latter two methods to give false indications.

Summary – In order to make the various design changes, certain production principles have been observed:

1. To secure interchangeability, it is advisable to avoid a multiplicity of connections, and, if possible, to have these connections in one plane perpendicular to the parting plane of the two assemblies, thus simplifying tooling. A glove-type connection with multiple screws, as in the case of the wing tip, is difficult because it violates this principle. On the other hand, the ring joint in the fuselage is in accord with it.

2. By far the major cost in labor is in assembly rather than part fabrication, so that every effort should be directed to simplifying assembly procedures and reducing the amount of work done on assembly, the emphasis being increased as the type of assembly approaches the stage of airplane final assembly.

a. Elimination of refrigerated "D" rivets is a welcome aid to increased production.

b. The fuel tank illustrates the principle of assembly simplification by reduction in number of parts, amount of joining, and accessibility of welding. The first two points are again illustrated by the incorporation of several fuselage sheets in a single one, even though the part fabrication cost may be increased. Cargo floor beams of magnesium extrusion versus built-up sheet metal beams further reflect the gain, not only in cost but in weight affected by reduction in number of parts.

c. Highly skilled and critical labor, such as welders, may be eliminated by the use of forged, pressed, or flash-welded parts.

3. With relatively large production, stressed metal parts are usually cheaper to fabricate than those of wood, and tend to be as light and more satisfactory in service. Nonstructural parts, carefully selected, often show weight savings and production gains as compared to metal.

4. Forgings of large dimensions, unless heavily stressed, are apt to be unduly heavy, and may require extensive machining to reduce weight. This factor may overcome production advantages inherent in forgings and render another form of construction superior. Considerable machining was necessary in the case of the landing gear upper truss forgings, and pressed steel parts were an improvement.

5. Assemblies that can be bolted together, as compared with welded assemblies, have definite advantages from the maintenance viewpoint, due to ease of replacement of component parts. The desirability of this feature in military as well as commercial airplanes has been pointed out by experts returning from the war zone.

Technical IDEAS for ENGINEERS

EXPERIMENTAL FLIGHT TESTING

by L. C. MILLER
Wright Aeronautical Corp.

■ **1944 Annual Meeting**

(Excerpts from paper entitled "Experimental Flight Testing from the Engine Manufacturer's Viewpoint")

EXPERIMENTAL flight testing of aircraft engines at the plant of the engine manufacturer is conducted to establish satisfactory engine operation (1) from the standpoint of the engine itself, and (2) from the standpoint of the powerplant installation features affecting the operation of the engine.

The first point relates mainly to mechanical functioning and is reasonably well established by test-stand operation. The second point has to be established to a larger degree in an airplane, since the scope of operation available on a test stand as compared to operation in the air is far more limited.

Some of the factors entering into engine operation in an airplane that are not provided in the test stand are:

1. The engine in an airplane is subjected to accelerations in three dimensions of space as well as operation in all attitudes with relation to gravity.

2. It is extremely difficult, if not impossible, to simulate altitude temperature and pressure variations on a sea-level stand and evaluate their effect on engine performance. This latter factor is believed to be the biggest reason why engine performance in an airplane might be different than on a test stand.

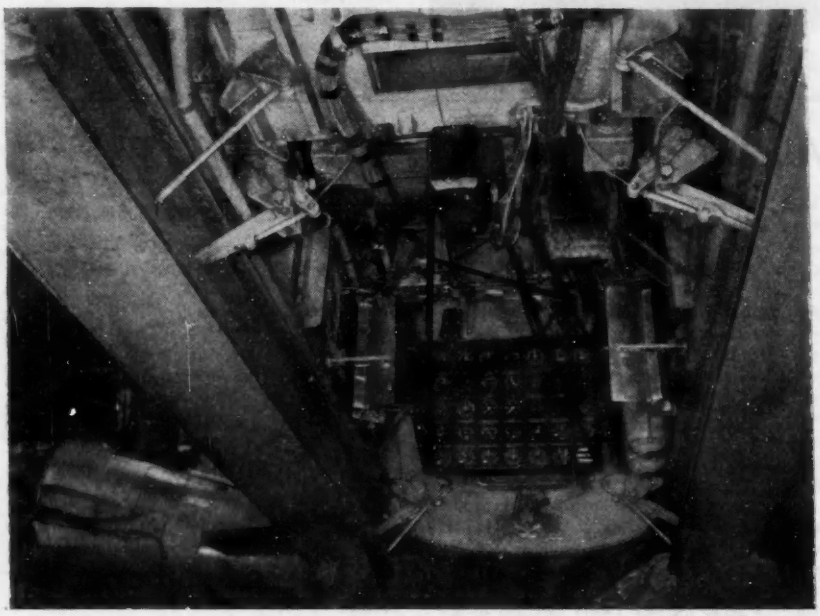
3. The engine is installed under different conditions of attachment rigidity in different airplane design applications.

4. The engine is installed in diverse installation arrangements in each airplane design application. By comparison, the test-stand installation is relatively standard and fixed, and is not confined to the space and arrangement limitations that each airplane design imposes on it.

Procedure – Data is attained by flying the airplane under prescribed conditions of powerplant operation and airplane attitude, and observing readings of data from instruments. These data must be corrected to standard conditions and then analyzed and presented for useful interpretation by persons concerned with its dissemination to engine design engineers within the plant and to powerplant personnel of aircraft design groups in the industry. In this way, a most thorough knowledge of how to anticipate satisfactory engine operation in ultimate service installations can be gained.

Selection of an Airplane – In most instances, the airplane selected will be one that is normally powered with a lower-powered engine, since the airplanes that are eventually to be representative of the type that the new engine model will be used in, are not yet available. Care must be taken not to attain too much of a compromise in airplane performance over what is ultimately to be obtained, as this constitutes a compromised test of the engine possibilities. Since it is desirable to test the engine to its ultimate critical range of performance, it is essential not to have it compromised in the flight-test airplane.

Considerable attention has been given to the question of building airplanes specifically for engine testing. Then, the engine manufacturer can design his installation with



■ **Fig. 1 – Panel installation showing instrument panel, camera, illumination, installation of lines, and disconnect panel**

Chrome Plating Aids Lubrication, Extends Engine Service Life

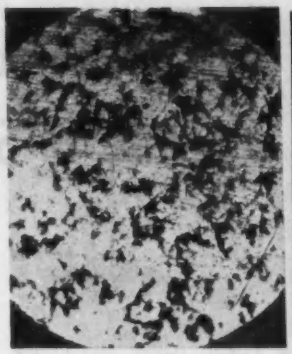
by **H. VAN der HORST and RUSSELL PYLES**
Van der Horst Corp. of America

▪ **1944 Annual Meeting**

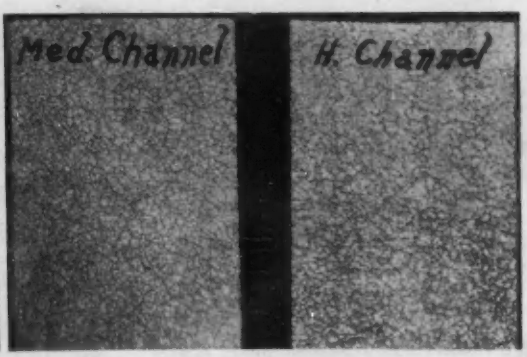
(Excerpts from paper entitled "Porous Chromium for Engine Cylinders")

POROUS chromium can be applied to steels of all descriptions, as well as cast iron, with adequate bonding. Recent developments indicate that equal success may be obtained in applying chromium to aluminum. Several methods are available for plating chromium on aluminum, but these methods call for a preplating of the base aluminum with either copper or nickel, and sometimes both materials. We believe that the desirable solution lies in the direct deposition of chromium on aluminum. Methods have been developed for accomplishing this, which show considerable promise of success, although experience in service types of engines has not been obtained.

Two types of porous chromium surfaces are now being used. One of these we term the "normal" porosity, and is illustrated in Fig. 1. The other, known as the "channel" type, is shown in Fig. 2. This type requires much closer control over all plating conditions. Cylinders of both types have gone into service, but most of the cylinders in diesel service are of the normal-porosity type because its production limits are wide. Recent experience has indicated that for some types of engines, there may be a preference, and it has been reasonably established that for airplane cylinders the channel type has somewhat superior characteristics.



▪ **Fig. 1 – Photomicrograph of "normal" porosity**

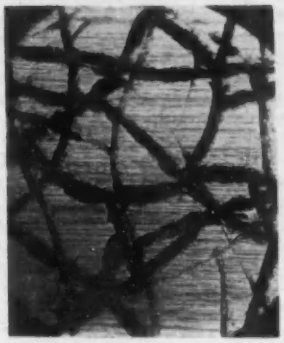


▪ **Fig. 3 – Sulfide print taken from airplane-engine cylinders having the channel type of porosity**

Surface Finish and Wettability – The low surface friction and oil wetting properties of porous chromium contribute to its performance in service. The rate of oil dispersion is greater on the normal porous chromium surfaces than on the iron or steel, and is still greater on the channel porous chromium.

It is believed that the oil film on the plateaus of both normal and channel finishes is very thin – perhaps only a couple of molecules thick – but not too thin to produce a slight change in the general color of the surface, and not too thin to play an important part in boundary layer lubrication. The mechanism of oil spreading on porous chromium is apparently capillary in character, a phenomenon not observed on steel or cast iron. The greater rate of dispersion on the channel type of surfaces can be attributed to the system of canals, which reduce the distance to be traveled by capillary action.

The pores and channels serve another useful purpose besides aiding in oil distribution. Pressures producing boundary lubrication conditions squeeze out the lubricant from between the mating surfaces. The channels and pores provide reservoirs wherein this oil can be trapped and be immediately



▪ **Fig. 2 – Photomicrograph of "channel" type porosity**

concluded on p. 42

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compromises from normal installation practice that may favor the purposes of the specific test. There are, however, disadvantages to this practice in so far as certain conditions characteristic of service airplanes might be avoided and thereby not result in a thorough test of all problems that might be experienced in service installations. There is also the problem that in the event of the loss of an airplane due to operational difficulties of an experimental nature, the replacement of the installation would be an expensive and time-consuming project.

Instrumentation – The instrumentation is one of the primary methods of proving or disproving the apparent operating characteristics of the installation.

Changing conditions during flight and the inadvisability of operating under certain conditions over extended periods of time make automatic recording of data a distinct advantage. Simultaneous reading of all variables often shows correlation when successively recorded readings show no agreement. Photographic recording of a test panel is an essential to good test data. (See Fig. 1.)

An automatic temperature recorder, such as the Brown flight-test recorder, relieves the pilot or observers of the nearly impossible task of recording the multitude of temperatures associated with tests involving engine cooling, supercharger performance, carburetors and associated ducting, and the like.

Obtaining Data by Flight Tests – Before an airplane is ready for flight test, a program is established that is based on the reason for preparing the installation. The program is set up either to confirm specific engine performance and functional characteristics for the model or to investigate service difficulties that may be experienced in the use of the engines in the field.

Flights tests are made specifically to establish characteristics relating to carburetion, power calibration, engine cooling, supercharging, lubrication system, engine scavenging and breathing, fuel system, ignition, vibration, and airplane performance.

On a specific flight test, pilot and observers are presented with a card indicating: conditions under which the airplane should be flown; specific powerplant operating conditions; data to be obtained by each.

The pilot's attention is focused as completely as possible on the apparent operation of the engine and the airplane. Any indication of operation other than normal is recorded and commented on in the pilot's report. By this method, the pilot is better able to note any physical characteristics of the engine operation, since he is not distracted by the problems of taking data manually.

Conclusion – It is evident from the large amount of flying done, the amount of data obtained, and the remedies accomplished for engine operational difficulties that much progress can be made in anticipating engine requirements in installation design and eliminating engine operation faults by a thorough program of flight testing of engine models at the plant of the engine manufacturer.

It is anticipated that future demands of refinement against service difficulties may result in flight testing being the basis of model test approval of engines for customers. Flight testing will thus become a prescribed part of the development program of new engine models.

Studies are underway of the factors involved in preparing a flight-test installation of a new engine model that will fulfill the requirements of a model test on which engine release may be based.

Discussion

In answer to several questions from Joseph Jerger, Curtiss-Wright Corp., Mr. Miller said that the present method of taking cylinder temperatures is very accurate and can be relied on if the temperature recorder is kept in proper adjustment.

Chairman Ray Kelly wondered how many readings can be obtained per minute on the automatic temperature recorder. One of the members of the audience said that it depends on the way the instrument is set, but an average figure would be 144 per min.

Technical IDEAS for ENGINEERS

Synthetic Rubbers Demand Closer Analyses of Service Requirements

(Excerpts from paper "The General Purpose Synthetic Rubbers in the Automotive Industry")

by **A. A. SOMERVILLE**, **R. T. Vanderbilt Co.**

▪ **1944 Annual Meeting, Jan. 11**

AUTOMOTIVE engineers must analyze their problems far more closely in designing for the use of synthetics than for natural rubber compounds. Some of the properties of synthetics are good, some not so good. Unfortunately, all the good properties are not contained in any one synthetic compound.

Only the essential properties must be demanded of any synthetics at the present state of the art. Although the rubber manufacturer is doing his best, he is working under handicaps beyond his control. Too little is now known about the behavior of the new compounds.

If flexing or fatigue life is paramount, for example, a designer should demand that characteristic, but he should not insist upon cold resistance unless that property is also essential.

Many automotive parts must be redesigned to permit a synthetic to be used to its best advantage. Furthermore, cost factors must be reconsidered in the use of synthetic compounds. Synthetics differ from one another in respect to price. The compounder must be trusted to select and recommend, regardless of cost, that material which his tests have shown to be the most suitable for your design and application.

The foregoing conclusions stem from a series of laboratory comparative tests of the properties natural rubber (polyisoprene), GR-S (butadiene-styrene copolymer), GR-M (polychloroprene), and GR-I (isobutylene-isoprene copolymer). Compositions of these compounds were made as nearly uniform as practicable.

	Natural Rubber	GR-S	GR-M	GR-I
Elastomer	100	100	100	100
Carbon black	50	50	37	50
Antioxidant	2		2	
Plasticizers	5	5	6	3
Curing agents	9.5	8.65	9	8.5

Because of the infinite variety of compounding possibilities, and the varied natures of the rubber products made from these compounds, it is impossible to make exact comparisons of the three general purpose synthetic rubbers (GPS) with natural rubber compounds.

The GR-S and GR-M compositions are decidedly more variable than is natural rubber, however. Output of GR-I has been so small that its behavior is still little known.

Processing of all three, that is, mixing, calendering, extruding, building, vulcanizing and stripping from molds, are generally poorer than properties of natural rubber.

Tests for tensile properties show that before aging, natural rubber is the best. During the oxygen bomb aging, however, GR-S (buna S) and GR-M (neoprene) show increased values:

STRESS AT 300% ELONGATION

	Before aging, room temp psi	Before aging, test at 212 F psi	After 72 hr oxygen bomb* psi
Natural rubber	2105	1170	1670
GR-S	1520	**	1960
GR-M	1685	800	1785
GR-I	305	110	325

* Bomb temperature was 176 F, and tests were made at room temperature following 72 hours of aging.

** Breaking elongation of GR-S at 212 F is less than 300%.

Before aging, rubber has the highest tensile both at room temperature and at 212 F, but after the aging periods, shown below, rubber has the lowest tensile when tested at room temperature:

TENSILE STRENGTH

	Before aging* psi	Before aging, test at 212 F psi	After 24 hr in oven at 250 F* psi	After 72 hr in oxygen bomb at 176 F* psi
Natural rubber	4180	2920	995	1775
GR-S	2695	855	1240	2255
GR-M	3285	1230	3430	2575
GR-I	2435	1120	2740	1990

* Tested at room temperature.

Both before and after aging, the GR-I (butyl) compound has a characteristically high elongation. The GR-S (buna S) has a low elongation when tested at 212 F, as shown by these test results:

ULTIMATE ELONGATION

	Before aging* %	Before aging, test at 212 F %	After 24 hr in oven at 250 F* %	After 72 hr in oxygen bomb at 176 F* %
Natural rubber	550	550	90	330
GR-S	450	240	120	370
GR-M	575	410	335	525
GR-I	870	1070	745	885

* Tested at room temperature.

The rubber compound showed greatest hardness under all conditions of test. All the compounds harden during aging, and the GR-S (buna S) showed the greatest increase:

SHORE HARDNESS
(Values after 30 sec)

	Before aging*	After aging, test at 212 F	After 24 hr in oven at 250 F*	After 72 hr in oxygen bomb at 176 F*
Natural rubber	68	66	78	71
GR-S	59	57	76	69
GR-M	65	62	76	70
GR-I	45	37	54	49

* Tested at room temperature.

The property of load/deflection is speci-

RESISTANCE TESTS

	Flex-cracking* Cycles	Cold** deg F	Sunlight*** Before Exposure Tensile psi	Sunlight*** After Exposure Strength psi***	Ozone Min to initial cracking	Ozone Min to complete cracking	Critical elongation range
Natural rubber	163,000	—68	4270	3115	½	23	20 – 30%
GR-S	14,000	—63	3345	620	½	23	25 – 60%
GR-M	1,000,000 showed slight cracking	—41	3495	3760	20	150	20 – 60%
GR-I	1,000,000 no cracking	—60	2805	2933	30	200+	50 – 60%

* Tested on National Flexing Machine, Model D.
** Temperature of initial retraction.
*** December, at Miami, Fla.

CHROMIUM PLATE

THE art of chrome plating of cylinder barrels is of importance during wartime, since surfaces so treated show a wear life several times greater than that of metals generally used. Used barrels that have worn beyond the point of efficient operation are being plated as a salvage operation, and a summary of the technique of plating such parts is pertinent at this time.

Chrome deposition is a relatively slow process, since only about 15-40% of the electrical energy deposits chromium, the remainder being lost as the result of hydrogen evolution. The physical removal of chromium from a deposit by grinding, honing, or lapping is also a slow, difficult procedure. Therefore, since the rate of deposition and removal of chromium presents such problems, cylinder barrels should be finished to the proper tolerances of out-of-roundness and taper prior to plating. Uniform diameters throughout the length of the sleeve prior to plating will require the minimum removal of deposit after plating in order to bring diameters within specification.

In finishing cylinders prior to plating, care should be taken that the entire cylinder surface is touched with the tool. Thought should also be given to the proper type of finishing tool, since both extremely smooth and coarse finishes are undesirable.

Properly prepared cylinder barrels for

fied by automotive engineers for torsional vibration dampers, bushings, and axle bumpers. Values resulting from tests showed the compounds to behave similarly as under the 300% elongation tests, above. Relative deflection value of the GR-I (butyl) was much higher than its relative tensile stress value when tested with load at 20% deflection. Tests were made under ASTM Designation D575-40T, and show the following values in psi:

Natural rubber, 305; GR-S, 205; GR-M, 260; and GR-I, 145.

On the other hand, all three synthetics have higher compression sets than does rubber, when tested at 400 psi, ASTM D395-40T, their respective values being:

Natural rubber, 10.5%; GR-S, 16.3%; GR-M, 17%; and GR-I, 24.5%.

Tests of adhesion to steel show rubber the best, with GR-I relatively poor at 25%, but GR-S and GR-M 94% of that of rubber.

Low heat buildup is required for axle bumpers. Tests on a compressed rolling ball machine, with samples loaded to 12.5 kg and a 10 min run showed:

	Temperature rise, F	% Compression
Natural rubber	85	7.7
GR-S	102	10.2
GR-M	69	8.5
GR-I	208	12.8

Again the behaviors agreed with results of the load/deflection tests. Compounds tested were loaded with carbon black and were thus relatively hard. It was found more difficult to make soft compounds with synthetics than with natural rubber.

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METAL SPRAY
Keeps Trucks Rolling

by W. R. HUBKA
Seattle Transit System

▪ **Northwest Section, Nov. 19**

(Excerpts from paper entitled "Operations of Motorized Equipment in Wartimes")

THE problem of maintaining fleets today is complicated by shortages of labor, parts, skilled mechanics, and by the lowering quality of motor fuels and the use of synthetic tires and tubes.

To meet the problem of mechanical maintenance, the metal sprayer has proven to be one of the most necessary pieces of equipment in repair shops, many parts being salvaged in a fraction of the time required by any other method. Such items as water pump shafts, shackle pins, bushings, differential gear bearing mounts, generator armature shafts, diesel governor shafts, and linkage are successfully rebuilt. Pinion gears are salvaged by building up bearing ends.

By welding we are reclaiming all of our trolley shoes and salvaging all broken trolley poles. Intake and exhaust valves can be successfully reconditioned by the use of high test steel and a facing of stellite.

When we were unable to get shift collars for Spicer constant mesh transmissions, we rebuilt the internal teeth in these collars by first drawing the temper from the collar and then building up teeth with stainless steel rod, shaping the teeth, and rehardening the gear.

Periodic mileage inspections must be kept up, but with the limited manpower this routine should be streamlined as much as possible.

Not knowing what future changes may be made in motor fuels, the full effect of lowering of octane and cetane values cannot be fully determined. However, lowering of octane values of gasoline will be detrimental to operation of high compression motors, especially in stop-start services.

The danger of mechanical difficulty is considerably lessened in this kind of operation with the smoother, slower-burning qualities of a high-octane fuel. However, motor lugging from the use of lower-octane fuels will inevitably result in bearing failure and piston etching due to the added explosion pressure and combustion temperatures.

To minimize repairs and eliminate the danger of damage due to mass operation, it will be necessary to make some changes in the motors if fuels of at least 76 octane are not available. Various changes are being tried, such as a spark retard, change in carburetor setting, and lowering of compression.

The lowering of the cetane value of diesel fuel will have ill effects, especially on jobs operating in city service. The use of cetane fuels lower than 45, which is recommended by most diesel-engine manufacturers as best for all-around operation, will result in harder starting, excessive smoke, and loss of power. The heavier low-cetane fuels will undoubtedly increase maintenance due to stuck rings and carbon on injector nozzles and tips.

Another problem is that of proper training and line supervision of drivers, for, with equipment in the hands of operators, many of them new, as much as 18 hr a day, careful operation of equipment is highly important. Employment of women as drivers and in repair shops has proved satisfactory; although they cannot take the place of a mechanic, they can be trained to do some of the small repair jobs and handle trolley coaches efficiently.

Lengthens Wear, and Permits of Salvage

by B. A. YATES
McQuay-Norris Mfg. Co.

▪ **1944 Annual Meeting**

(Excerpts from paper entitled "Summary of Technique of Chrome Plating of Cylinder Barrels")

plating require a uniform thickness of deposited plate, and to accomplish this, it is necessary to orient and align axially the cylinder with respect to a circular electrode of proper length from which flows the current. Proper and uniform interelectrode distance (spacing between cylinder and anode) is absolutely necessary if a uniform plate is desired. The use of stopoff waxes, tapes, and extension rings may also be helpful in chromium plating certain types of barrels if a uniform plate is to be secured.

Bond adherence between the chrome and the base metal depends upon the cleaning procedure and etching prior to actual plating. A satisfactory procedure for cleaning is to degrease in a vapor degreaser, followed by alkali swabbing, rinsing, and then scrubbing the surface thoroughly with pumice, using a power-driven circular fiber brush. The pumice is easily rinsed off with clean water, after which the barrel should be electrochemically etched in a chromic acid-sulfate bath (preferably of the same composition as used for plating).

The conventional "Fink" bath containing 250 g of chromic acid and 2 g of sulfate ion per liter gives a satisfactory deposit. Uniformity of temperature throughout the bath is quite important, since cathode efficiency decreases with increasing temperature, resulting in varying rates of deposits throughout the cylinder barrel, depending on the local temperature. In connection with effect of temperature on the quality and rate of deposit of chromium, it is desirable to maintain terminal voltages as low as possible commensurate with the current densities desired.

Cathode current densities of 3 to 4 amp per sq in. are generally used for plating, the lower value for steel barrels and the higher figure for cast iron.

Temperatures usually range from 120 to 150 F, the choice depending on the type of deposit desired, and in order to ensure the correct temperature, the solution can be violently agitated either by mechanically propelling the liquid or by compressed air ebullition.

A variation of the bath temperature, in addition to affecting the rate of deposit, also affects the quality or texture of the plate. Chromium, when deposited, develops cracking, which is readily discernible under the microscope. An increase in temperature causes the development of a larger crack pattern than found when plating at lower temperatures.

Parts requiring a minimum amount of removal of chrome after plating for sizing are usually plated at the lower temperature range, since the disintegration or removal of material mechanically seems to be a function of the crack pattern developed during the plating cycle. The pattern crack width as developed in the plating bath can be enlarged or intensified, such as by anodizing the plated part. Various types of solutions for the anodic treatment can be used; however, the chromic acid-sulfate bath is used since this separate bath can be used for etching prior to plating and the subsequent anodic treatment after plating.

The anodic process essentially results in the removal or solution of chrome from the entire irregular surface of deposits, and while temperature fluctuations will change the rate of removal, there is apparently no effect on the character of the fundamental pattern by varying this factor.

In addition to the fact that chromium cylinder barrels that have been specially treated following chrome plating are considerably easier to size, experience and tests seem to indicate that it is possible to create a surface, the oil-retaining characteristics of which under lubricating conditions are considerably improved, with the result that the seating or mating in qualities between the rings and cylinders are also seemingly improved, resulting in a greater overall efficiency and wear life.

Technical IDEAS for ENGINEERS

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AIR FUTURE

Promises Many Changes

by J. G. GOODENOUGH
Adel Precision Products Corp.

▪ *Southern California, Jan. 7*

(Excerpts from paper entitled "Aircraft Engines, and Their Accessories")

AIRPLANE developments we are likely to see in the near future are:

1. Power units in the 5500-7000 hp class.

2. The use of 2-cycle sleeve fuel-injection engines as the most convenient means of attaining these high powers. The virtues of the sleeve-valve engine are, first, the use of a sleeve valve permits the engine to breathe through gills rather than through nostrils, and allows the designer almost complete freedom in his arrangement of the cylinder head; second, it can operate against higher back pressures than can the poppet-valve engine without any of the valve gear being unduly distressed. This makes it particularly suitable for use in conjunction with an exhaust turbine driven supercharger.

3. The continuance of the spark-ignition engine, of the 2-cycle fuel-injection type, for hauls up to 12-hr endurance.

4. The use of 2-cycle compression-ignition engines for long-range operation.

5. The divorcement from the main engines of all those accessories which are not required for the operation of the main engines. Eventually, development may proceed along the lines of having all such units as are not required for the actual functioning of the engine—generators, hydraulic pumps, vacuum pumps, air compressors, and so forth—driven by an independent source of power installed either in the wing or the hull of the airplane. This would clear up the back end of the engine, would greatly facilitate maintenance and simplify the task of changing engines, when this became necessary.

6. The use of separate powerplants, probably installed in the fuselage of the airplane, which will provide all of the airframe services, as distinct from the propelling services.

7. Increased attention being paid to accessibility and to rapidity of engine changes.

8. Adoption of interchangeable powerplants, as distinct from engines, which can be installed complete in a number of different types of aircraft.

Discussion

Asked, what are the differences in the vibrational forces between the three engines mentioned, Mr. Goodenough answered that in a 12-cyl V 2-cycle engine the difficulties of mounting and the vibration characteristics were no harder to overcome than were those in a 4-cycle engine of equal swept volume. In fact, the problem is easier, he said, because the 2-cycle engine weighs about 20% more than the 4-cycle engine having the same cylinder arrangement and swept volume, so that the inertia of the 2-cycle engine assists in dampening out any vibrations which may have been present.

Oil consumption of a sleeve-valve engine, Mr. Goodenough declared, is no higher than that of the poppet-valve engines of the same dimensions and running at the same speeds. The initial consumption may be slightly higher when the engine is new, but the gross oil consumption over the life between overhauls of the engine—500 to 700 hr, is lower than is that of a poppet-valve engine.

Mr. Goodenough described, at the request of one of the audience, the present state of development of water injection. The purposes of water-alcohol injection are: to permit the operation of engines at powers which, without the use of water-alcohol, would cause serious detonation and overheating. Water and alcohol are sprayed into the induction system on the upstream side of the supercharger; then are evaporated by the temperature rise in the supercharger as they pass through it. This results in a lowering of the charged temperature, which in turn causes a decrease in the temperature of the whole cycle of operation, and so reduces the tendency of detonation. The second purpose is to enable an engine, which is designed to operate on a fuel of a certain octane rating, to carry its full power on a fuel of lower octane rating without detonation.

In considering the possibility of developing the use of very high-speed engines for high powers, Mr. Goodenough explained that we must distinguish between rotational and piston speed. Although piston speeds of 55 fps are high, he does not recommend the use of very high rotational speeds, which, he said, "would limit us to comparatively small cylinders and would force us to design an engine having a very large number of such cylinders. This would not be practical because of the physical difficulties of arranging the manifolding and supply services generally to that very large number of cylinders."

Commenting on the propeller problem for a 6500-hp engine, Mr. Goodenough said that, since some propellers today can absorb 3000-3500 hp as a single propeller, then a contra-rotating propeller, having the same diameter and blade form as is now being used in the straightforward version, could be employed to absorb the 6500 hp.

TEST RUNS

THE object of this paper is to discuss the specific types of tests conducted in the development of high-output aircraft engines in order to familiarize those connected with the efforts of the aircraft-engine manufacturer in his quest to produce the most reliable and economical powerplant possible. For the sake of logic, let us consider the tests performed with a newly designed engine in the proper sequence.

Preliminary Run and Calibration—Upon completion of the design of an engine, preliminary tests are conducted to determine the durability and to investigate the adjustments and changes necessary to make the engine durable for calibration check. When preliminary tests indicate a sufficient degree of durability, the engine is made ready for a dynamometer calibration to determine the power characteristics. It is this test that proves whether or not the design meets the performance requirements. Calibration tests consist of a variety of types of curves run to determine specific characteristics of the engine depending on the test objective. The output capacity of the engine, which is a primary consideration during the early stages of development, is best determined by a series of manifold pressure curves run under both sea-level and altitude conditions of the intended operational speeds.

Durability Tests—These tests consist of a variety of types of operation depending on the test objective. The purpose of all endurance block testing is to bring out the inherent structural weaknesses with the objective of correcting them.

Vibration—Vibration tests are also conducted on the test stand. To permit the use of a flight-type propeller on endurance test, it is necessary to check the propeller blade stresses to determine whether the stresses encountered are permissible. The blade tip and shank stresses, which are checked with the cooperation of the propeller manufacturer, are determined by means of electrical pickups attached to the blades at the critical sections.

Nacelle Tests—A recent trend in test-stand work has been the adoption of a complete nacelle assembly mounted on a 30-ft cable stand with the coolant air directed at the front of the engine by a jet blower. With this arrangement, it is possible to subject the engine to surroundings similar to those expected in the airplane. The use of the nacelle makes it possible to duplicate the oil system used in the airplane to the last detail, which is impossible on the conventional type of stand, due to differences in the oil cooler, length of lines, oil tank, fittings, and so forth.

Torquemeters—Though the performance curves based on dynamometer operation are made available for the use of the operator in the field, a means of checking engine performance under actual flight conditions is highly desirable. The use of the torquemeter has proved satisfactory in fulfilling this requirement, especially in checking

by J. O. CHARSHAFIAN
Wright Aeronautical Corp.

▪ *1944 Annual Meeting*

(Excerpts from a paper entitled "Aircraft Powerplant Development Testing")

ay Good Profits By reventing Troubles, mproving Operation

horsepower output with altitude and specific fuel consumption. Fig. 1 shows the fundamental principle of operation. Crankshaft torque is transmitted through a reduction gear system to the propeller shaft. The propeller shaft pinions apply a torque to the reduction stationary gear, which is attached to an adapter incorporating a race for the balls on which it is mounted, thus leaving the adapter free to rotate. The movement of the adapter is restricted, however, by oil pressure acting on the torquemeter piston, and thus opposing the torque of the adapter arm. The accuracy of the torquemeter depends on the proper regulation of this oil pressure for the torquemeter horsepower.

Oil flow is supplied to the torque cell by a constant-displacement gear pump mounted on the engine and is metered through a slot and drained into the engine oil sump.

In order to prove that a torquemeter is reliable, an engine is installed on a dynamometer stand and the dynamometer horsepower is checked against the torquemeter horsepower under the various conditions. When the torquemeter horsepower checks accurately within ±2% of dynamometer horsepower under all conditions, it is considered satisfactory, since this tolerance is within the accuracy of dynamometer equipment.

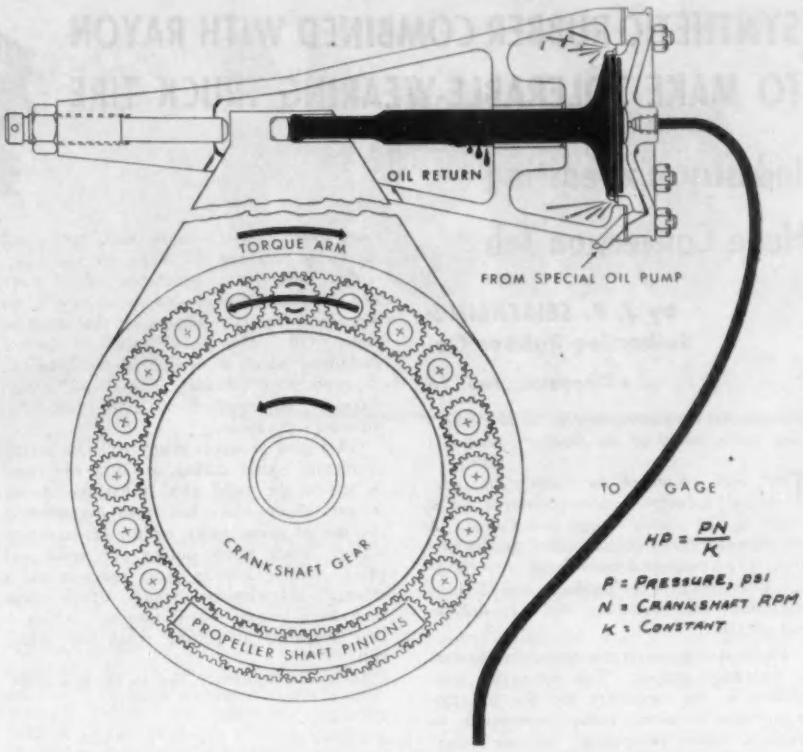
Lubrication, Scavenging, and Heat Rejection – The most effective means of determining the distribution of the total flow within an engine is by segregating the various sections and draining them independently by auxiliary scavenge pumps. Thus, it is possible to determine the oil flow in the nose section, the front main crankcase, the rear main crankcase, the front supercharger housing, and the rear supercharger housing.

Having determined the distribution of the oil, it is possible to investigate and eliminate excessive flows caused by internal leaks. In multibank-cylinder engines the equalization of the main crankcase oil flows is extremely important.

Once the oil flow has been established, the ability of the engine to scavenge the oil is tested. Scavenging checks are performed at rated and take-off power and speed conditions and also at diving speeds, since scavenging under these conditions is most critical.

Establishing the minimum possible oil flow for safe operation and providing the most efficient scavenging are means of keeping the heat rejection to the oil at the lowest possible figure. Retaining a small quantity of oil in the engine by efficient scavenging promotes less churning of the oil by the rotating engine parts, and thus results in less heat absorption, which is conducive to low heat rejection.

Propeller Overspeed Tests – Considerable propeller overspeeding tests have been conducted on the test stand. The important factor of forward velocity has an effect on the degree of overspeeding in the airplane, which is lacking on the test stand, but the instrumentation possibilities more than overcome that disadvantage. Tests conducted on the test stand are comparative and serve as a reliable means of evaluating changes intended to reduce overspeeding.



■ Fig. 1 – Diagram showing principle of operation of the torquemeter

Minimum Fuel Consumption – An investigation that is perpetually in progress consists of the effort to reduce brake specific fuel consumption. Tests conducted thus far with antidetonants mixed with the fuel change the entire complexion of the detonation problem. Currently, the basic limitation in the use of leaner fuel-air mixtures is detonation, which is prevented at the higher outputs by use of rich mixtures. Before fuel consumption can be reduced, the cooling of the cylinder accomplished by rich fuel-air mixtures must be achieved by some other means.

Oil Leaks – The most annoying problem to the operator is the presence of oil leaks in the field. With this in mind, tests have been formulated for the purpose of determining leakage characteristics of various types of seals. Inasmuch as seals of one form or another invariably incorporate a compressible material such as rubber, the effect of heat as a destructive element is important. Vibration is also a contributing factor to the problem. The tests, therefore, have been designed to produce these detrimental effects.

Discussion

H. M. Martin, General Electric Co., questioned the author's statement that torquemeter horsepower checks accurately within ±2% of dynamometer horsepower, which is within the accuracy of dynamometer equipment. Mr. Martin said that most dynamometer equipment with which he was acquainted had a tolerance of ±¼%. Mr. Charshafian explained that the dynamometer equipment for higher-output engines have the tolerance he mentioned, but on the newest equipment available, the tolerance may be better.

Commenting on Mr. Martin's statement that the planetary gears are designed to have an efficiency of 99%, so that they have little effect on the accuracy of the torquemeter, the author explained that the efficiency of these gears does have some effect on the accuracy, but only one-half of the error in the gears enters into the accuracy of the torquemeter because the loss between the driving gear and the pinion does not enter, only that between the pinion and the stationary gears has an effect.

Chairman A. T. Gregory asked how good was the correlation between the service tests mentioned by the author and field operation. Mr. Charshafian said that as regards sludge accumulation and many other factors, the correlation was very good. Chairman Gregory also asked if any teardowns are made during the 600-Hr Service Operational Endurance Test. Mr. Charshafian stated that the objective was to run the test without any teardown, although this is not always possible. Complete wear measurements are made before and after the test, as in the field.

Another member of the audience wondered about the use of detonation indicators. The author said that these have proved quite satisfactory; that on all calibration tests detonation pickups are used. They should also be used in flight, he added.

SYNTHETIC RUBBER COMBINED WITH RAYON TO MAKE TOLERABLE-WEARING TRUCK TIRE

Industry Expediting Huge Conversion Job

by J. P. SEIBERLING
Seiberling Rubber Co.

▪ **Canadian, Feb. 16**

(Excerpts from paper entitled "War Production Achievement of the Rubber Industry")

THE high points of the rubber manufacturing industry's accomplishment as it relates to the United States and Canada in approximate chronological order are as follows: (1) compound conversion, (2) product conversion, (3) product and process innovation and invention, and (4) utilization of GR-S.

The first big conversion was from natural to reclaimed rubber. Following this conversion, it was necessary for the industry to go from reclaimed rubber compounds to synthetic rubber compounds utilizing different synthetic rubbers such as neoprene, thiokol, butyl and GR-S – all involving the use of new chemicals, fillers, curing temperatures and periods of cure. While there is much to be learned in this new art, there is no doubt but that we are going to come out of this war with better compounded synthetic rubbers, and probably the discovery of new synthetic rubbers that will surpass anything produced to date.

The second great conversion, product conversion, was not as exacting a task as that involved in compound conversion, but it was a larger one in that it concerned conversion of the industry's space, machinery, methods and skills, devoted prior to the war to the manufacture of tires, tubes, mechanical goods, drug sundries, and so forth, to the manufacture of an amazing new list of articles, some of which were similar to rubber, others totally dissimilar.

The third high point, product and process innovation and invention, is a thrilling success story that can be told only when the war is over. It will be a story of a new compound development coming from bitter hours of laboratory experimentation – a development that changed a production method with an expected 92% defective product to a production where the defective product was less than 3%. It will also be the story of the invention of a new machine which increased output 103% and helped to relieve a desperate labor shortage.

The last high point is the utilization of GR-S (which stands for Government Rubber – Styrene), the new synthetic rubber. Actually, this resembles rubber only in its elasticity and property of resilience, but it reacts in a manner different from natural rubber, and handles differently. It is superior to rubber in its resistance to abrasion and the deteriorating effects of oil and gasoline, but in all other respects it is inferior.

The principal difficulties involved in utilizing GR-S are in its slow compounding. It takes much longer to mix with the various chemicals required to make its use practical. Thus, more machinery, floor space and manhours are needed to prepare it for use and in the later processing that must be done. GR-S also lacks "tack" or natural stickiness, which is needed in the handling of rubberized fabrics. This "tack" must therefore be supplied by extra rubber-cementing operations.

GR-S also produces many difficult curing problems. After curing, a GR-S tire must be left in the mold until it has cooled, for it tears easily while hot, thus necessitating the use of many more molds, or expecting a very much lower output per mold and press. When used in inner tubes it has a strange characteristic which development men have termed "static fatigue," which is best described as getting worn out sitting still.

Its worst deficiency lies in its heat-creating propensities and its inability to withstand high temperatures. It heats up in use much faster than natural rubber, and when the temperature reaches a certain point it suddenly disintegrates. This heat difficulty is particularly pronounced in truck tires, where it is necessary to have a heavy, thick carcass in order to carry the heavy loads required. The industry has adopted rayon cord for truck carcasses in place of cotton, because rayon cord permits lighter carcasses with thinner sidewalls, and still provides the necessary tensile strength. Because of the thinner, lighter carcass made possible with rayon cord, the heat generated from using GR-S is less pronounced, and thus at least a tolerable-wearing truck tire utilizing about 70% synthetic rubber is made possible. In learning how to use and process this new GR-S synthetic rubber, the rubber manufacturing industry has effected a very real accomplishment in a very short time.

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"Horse Sense" Engineering Multiplies Aircraft Engine Production and Power

by A. T. COLWELL
Thompson Aircraft Products Co.

▪ **Southern California, Feb. 18**

(Excerpts from paper entitled "Engineers and Horses")

AIR power is world power – air power is horsepower. In developing aircraft engines, good engineering judgment or "horse sense" plays as important a part as strictly technical data. Aircraft engine production went from virtual stagnation in 1938, when the entire industry produced only 10,000,000 hp, to an output astounding alike to enemies and allies in 1943, when the total was 339,583,000. Last December the total electric power capacity of the nation was 66,050,000 hp. Military engine horsepower produced in that month alone was 34,900,000 hp.

Production time and costs have been appreciably reduced – cost per horsepower is one-third lower on aircooled engines. More important, the time between major overhauls has been more than doubled on both aircooled and liquid-cooled engines for military use, indicating great reliability in the field, even with increased production.

Faced Problems

The automobile industry was confronted with many problems as licensees. Aircraft engines produce 10 or more times the power of automobile engines, yet at one-fifth of the weight per horsepower. This means highly stressed parts, necessitating good engineering judgment in design. For instance, one exhaust valve of a 2000 hp aircraft motor handles the entire output of an automobile engine. Automobile flywheels would burst at the operating speeds of a supercharger impeller which must be balanced to 0.01 oz-in. Some parts are handled with wax paper to prevent acid etch from hand perspiration, and eventual failure. Some assemblies are made in temperature controlled rooms, so precise are the fits required. An automobile connecting rod requires only 29 machining operations, an aircraft rod 86. Shot blasting and nitriding are used on some parts, and some bolt holes are honed to withstand the greater stress.

Machining Time

An automobile block requires less than 8 hr of machining time; while the Rolls Royce block requires over 60; the camshaft 62 hr versus 3.3 for an automobile camshaft.

Wright Aeronautical has increased production 30-fold, exclusive of licensees, and Pratt and Whitney alone produced 5,000,000 hp in the month of August. Packard has put the Rolls Royce engine into volume production in a short time. Buick, Chevrolet, Continental, Ford, Jacobs, Nash and Studebaker have all contributed innovations in the production of high power engines, and Chrysler

concluded on p. 42

News..

..OF THE SOCIETY

W. E. B.

Members Cite Need of Post-War Cooperation

WHAT GREATER engineering and research coordination and cooperative effort have done for the nation during the war period shows conclusively that continued coordination in industry will be equally valuable in the post-war period, members of the SAE War Engineering Board and its Iron & Steel Committee agreed at a meeting Feb. 15 in Detroit.

"The Society has clearly demonstrated since its organization 35 years ago, during the emergency of World War I, and in its accelerated engineering advisory programs to the Government today, that it can perform a wide range of needed services in areas in which no other organization can effectively work," J. M. Crawford, Chevrolet's chief engineer, said.

"With this background of past and present activity, the Society is in an excellent position to continue its work, wherever needed, in the post-war era when we will all be faced with unprecedented problems," he continued.

Sees New Problems

"It is apparent that in the scramble and confusion in the whole field of metals following the war, automotive manufacturing companies will have limited success in solving the attendant technical problems individually. Therefore, industry will need such committees as this iron and steel group on questions of ferrous metals, and other committees on new problems in non-ferrous and non-metallic materials," Chairman Zeder of W.E.B. said.

"Inevitably there will be technical problems on rubber and petroleum which could best be handled by special committees in these areas," he said.

The W.E.B. Iron & Steel Committee, L. R. Buckendale pointed out, will be of help in the serious scrap situation, wherein the carbon scrap largely goes to the bottom of the ocean, but alloy scrap is coming back into melt in such quantities that we will be faced with a condition which will require a great deal of expert technical work. The confusion in cast steel specifications does not permit a designer to know what he can expect to get when he is working out his designs.

With both the present emergency and the post-war period in mind, H. B. Knowlton suggested that the Iron & Steel Committee of W.E.B. be broad enough to include problems of tractor and implement industries because of the similarity of their products. In this the Steering Committee concurred unanimously.

"Because every competitor can cut up your product and tell what you have within three months anyway, there is no loss in the competitive position in the exchange of development information. On the other hand, an all-out cooperation on the domestic industrial front will help to place our country in a much stronger position in the markets of the world," Mr. Crawford said when the question of peacetime competitive practices was raised.

Reasons for Continuation

Specifically, F. E. McCleary suggested that the Iron & Steel Committee continue its work in order to:

1. Carry on the present study of steel classifications;

2. Maintain the needled (special addition agent) steel project;

3. Hold regular meetings with the Armed Services and other Government agencies on technical problems to promote continued understanding and cooperation;

4. Set up projects to solve difficulties accruing from the changeover from armament to peace steels;

5. Work on the probable increase of residual alloys in steels in respect to stampings from sheet and strip and their effect on forming and possible design change requirements on fenders, panels, and other automotive parts; wire forming; heat-treated cold drawn bars, and other problems.

Other unsolved problems which could be attacked by the effective cooperative work of the SAE committees, suggested by members of the group, include:

1. Chemical allowances beyond specifications;

2. Size and out-of-round tolerances;

3. Decarburization, such as in cold springs from hot rolled material, and the rolled threads on bolts and studs upset or extruded from cold drawn wire;

4. Standardization of magnaflux inspection;

5. Coordinated study of the progress of non-ferrous materials in manufacturing;

6. Study of new manufacturing operations.

It was agreed that engineers of the industry are devoting a great deal of time and spending thousands of dollars in tearing down competitors' products to study materials, heat treating, and other phases of manufacturing. Many of these conditions could be cleared accurately through groups such as this with very little cost—but of great benefit.

To Disseminate Techniques

Thus progress in heat treating and new equipment, machinability, tools, cutting compounds, and other features of almost limitless extent and of great value could be discussed and accurately reported, he said.

This is the practical and logical way to solve problems of great economic importance. Such continuation, and expansion where needed, of the work of this committee would make its work the most important now existent in all metallurgical effort, Mr. McCleary believed.

Promoted to Colonelcy

COL. J. H. FRYE

Chief of the Materials Section, Technical Division, Office of the Chief of Ordnance, J. H. Frye has been advanced from lieutenant colonel in the Ordnance Department to full colonelcy. As a representative of Major-Gen. G. M. Barnes, chief of the Ordnance Technical Division, Col. Frye has been the chief liaison officer between the Army and the SAE War Engineering Board and has been assigned the W.E.B. major projects on the conservation and substitution of materials.

Coordinating Research at Work on Grease Problems

Typical of the close cooperation of industry technologists and experts of the Army Ordnance Department is the work of the SAE-API-sponsored Coordinating Research Council's Advisory Group on Greases. The group is shown here working with representatives of three Army Arsenals at the Rock Island Arsenal. Recommendations on various phases of the project have been submitted to the Army, and the Group is continuing its work on other tasks involved in simplifying grease specifications. Seated, left to right, are Florence L. Meshkov, Frankford Arsenal; C. L. Knopf, Sinclair Refining Co.; E. A. Adams, Standard Oil Co. (Ind.); M. Jacobson, Watertown Arsenal; H. Gisser, Frankford Arsenal; C. B. Veal, secretary, CRC; Walter G. Ainsley, chairman, and Major N. W. Faust, both of the Office of the Chief of Ordnance; J. C. Zimmer, Standard Oil Development Co.; T. G. Roehner, Socony-Vacuum Oil Co.; Gus Kaufman, The Texas Co.; C. W. Georgi, Quaker State Oil Refining Co., and E. W. Aldrich, National Bureau of Standards. Standing, left to right, are Major P. C. Cunnick, Capt. A. C. Hanson, F. E. Woodward, J. W. Arkis, T. P. Donnelly, and G. O. Inman, all of Rock Island Arsenal

Future Design of Accessory Drives Guided by SAE ARPs

TO guide the design of future equipment, an envelope drawing of an aircraft auxiliary driven generator has been approved by the SAE Aeronautics Division, and published.

The Aeronautical Recommended Practice (ARP 71) covers the mounting pad and flange of 8 in. bolt circle. It shows the proposed mounting pad and drive, location of the cooling air inlet, and the clearance necessary for installing and removing the generator. This is the first time this item has been covered by an envelope drawing.

Another Aeronautical Recommended Practice (ARP 72) covers the mounting flange, pad, and drive-accessory gear box of the 10-in. bolt circle dimension. It shows the pad and flange dimensions, bolt locations, and spline dimensions.

The projects were developed by Committees A-2, Aircraft Electrical Equipment, headed by C. C. Shangraw, Eclipse Pioneer Division, Bendix Aviation Corp., and E-2, Engine Accessory Drives, headed by G. N. Cole, Pratt & Whitney Aircraft.

Engine Mounting Pad, Drive Standards Issued by SAE

SEVEN new and revised Aeronautical Standards have been approved by the SAE Aeronautics Division covering aircraft engine mounting pads and drives. They are:

AS 46 (new) Generator Mounting Pad and Drive, 4 Bolt;

AS 47 A (revised) Pump, Fuel, Mounting pad, and Drive;

AS 48 A (revised) Gun Synchronizer, Mounting pad, and Drive;

AS 49 A (revised) Pump, Vacuum or Hydraulic, Mounting pad, and Drive – Type I;

AS 50 A (revised) Pump, Vacuum or Hydraulic, Mounting pad, and Drive – Type II;

AS 51 A (revised) Pump, Vacuum or Hydraulic, Mounting pad, and Drive – Type III, and

AS 55 A (revised) Tachometer, Mounting pad, and Drive, Type II.

These projects were developed by Committee E-2, Engine Accessory Drives, under the chairmanship of G. N. Cole, Pratt & Whitney Aircraft, with the coordination of Committee A-2, headed by C. C. Shangraw, Eclipse Aviation Division, Bendix Aviation Corp.

Prop Shaft End Thread Cap Standard Approved, Issued

A NEW standard for protector caps for aircraft propeller shaft end threads has been approved by the SAE Aeronautics Division, and is being issued from SAE headquarters on one page.

It covers the 7½, 10, 20, 30, 40, 50, 60, 70, and 80 propeller shaft sizes and is complete with drawings, dimensions, and manufacturing notes.

Protectors are widely used in industry to prevent marring the threads during manufacturing, and in some cases in shipping the shaft ends.

The work was done by Committee E-5-A, under the chairmanship of M. E. Mills, Wright Aeronautical Corp.

Extends Scope of Authority Of SAE War Activity Council

EXTENDING the scope of authority of the SAE War Activity Council, the Executive Committee of the SAE Council has given the WAC power to act as the Society's assignment agency on new post-war technical projects requiring consideration between now and the cessation of hostilities.

The action is subject to the approval of Council.

Chief consideration for the extended scope is the natural tendency for technical committees, operating under the SAE War Activity Council, to turn more of their thinking to problems of the post-war period upon completion of specific assignments from the Army and other Government agencies. In the meantime, many of the peacetime technical committees of the Society are also turning their attention toward the post-war period. This extension of scope will tend to prevent overlapping of effort.

The SAE War Activity Council is under the chairmanship of B. B. Bachman. With the bulk of the Society's normal peacetime technical activity represented, correlation of projects is assured.

CRC Test Procedures and Forms Are Available

IN 1942, the Coordinating Research Council, Inc. was organized jointly by the American Petroleum Institute and the Society of Automotive Engineers, its object, as stated in the certificate of incorporation, being to

"encourage and promote the arts and sciences in directing scientific cooperative research in developing the best combination of fuels, lubricants, and equipment powered by internal combustion engines; to promote, coordinate, and correlate cooperative research on petroleum products and their application to and utilization in automotive and aeronautic equipment; and to afford means of cooperation with the Government on related matters of national interest."

Research sponsored by the three technical committees of the Council (Coordinating Fuel Research Committee, Coordinating Equipment Research Committee, and Coordinating Lubricants Research Committee) has resulted in the development of a number of test procedures.

The following list indicates those which are currently available:

PUBLICATIONS OF THE COORDINATING RESEARCH COUNCIL, INC.*

CRC Designations	Title	Price
L-1-243	CLR Procedure for Determining in an Engine the Effect of Engine Oils on Ring-Sticking, Wear, and the Accumulation of Deposits	$0.50
L-2-243	CLR Procedure for Determining in an Engine the Break-In Characteristics and the Load-Carrying Ability of an Engine Oil	.50
L-3-243	CLR Procedure for Determining in an Engine the Stability of an Oil and its Tendency to Corrode Copper-Lead Bearings	.50
L-4-243	CLR Emergency Procedure for Determining Oxidation Characteristics of Heavy-Duty Crankcase Oils	.50
L-5-243	CLR Procedure for Determining in an Engine Oxidation, Ring-Sticking, Detergency, and Bearing-Corrosion Characteristics of Heavy-Duty Crankcase Oils	.50
L-7-443	Required Engine Preservative Oil Characteristics	.50
L-8-743	Inspection Form for Radial Air-Cooled Engines 50 to 500 sets – $7.50 per lot of 50 sets, 500 sets or more – $5.00 per lot of 50 sets.	
L-11-1143	CLR Procedure for Determining Stable Pour Point of Diluted SAE 10 Grade Oils	.50
L-12-1143	CLR Procedure for Determination of Foaming Characteristics of Lubricating Oils	.50
F-1-543	CFR Research Method of Test for Knock Characteristics of Motor Fuels	.25
F-2-543	CFR Motor Method of Test for Knock Characteristics of Motor Fuels	.25
F-3-543	CFR Lean Mixture Method of Test for Knock Characteristics of Aviation Fuels	.25
F-4-443	CFR Supercharge Method of Test for Knock Characteristics of Aviation Fuels	.50
F-5-543	CFR Method of Test for Ignition Quality of Diesel Fuels	.25
F-6-943	CFR Procedure for Testing the Starting and Warming-up Characteristics of Motor Fuels	.50
F-7-1043	CFR Test Procedure for Determination of Vapor Lock in Ground Vehicles	.50
E-1-943	CER Procedure for Determination of Octane Number Requirements of Vehicles on the Road	$1.00
	CFR Procedures for Determination of Anti-Knock Quality of Fuels on the Road	
F-8A-943	Borderline Procedure	
F-8B-943	Modified Borderline Procedure	
F-8C-943	Knock Intensity Procedure	
	CER Procedures for Determination of Effect of Spark Timing on Engine Power	.50
E-2-943	CER Road Test Procedure for Determination of Effect of Spark Timing on Engine Power	
E-3-943	CER Chassis Dynamometer Procedure for Determination of Effect of Spark Timing on Engine Power	
E-4-943	CER Procedure for Maximum Power and Knock Tests on Dynamometer	
E-5-943	CER Procedure for Maximum Power and Knock Tests on Chassis Dynamometer	
	Report of the CFR-AFD Cooling Liquids Groups entitled "Properties of Ethylene Glycol and its Aqueous Solutions"	.50

** Those publications or latest revision thereof may be obtained on order addressed to the Coordinating Research Council, Inc., 30 Rockefeller Plaza, New York, 20, N. Y. Order must be accompanied by check payable to the Coordinating Research Council, Inc., and include the New York City sales tax of 1% if delivery is to be made within New York City. (Stamps not acceptable.)*

(Certain of these publications are in a restricted category, and therefore, cannot have general distribution.)

CRC FORMS

CRC Designations	Title	Form No.	Price
L-1-243	CLR Procedure for Determining in an Engine the Effect of Engine Oil on Ring-Sticking, Wear, and the Accumulation of Deposits.	C-1-2144 3p	$1.00 per pad
L-2-243	CLR Procedure for Determining in an Engine the Break-In Characteristics and Load-Carrying Ability of an Engine Oil.	C-2-2144 2p	$1.00 per pad
L-3-243	CLR Procedure for Determining in an Engine the Stability of an Oil and its Tendency to Corrode Copper-Lead Bearings.	C-3-2144 3p	$1.00 per pad
L-4-243	CLR Emergency Procedure for Determining Oxidation Characteristics of Heavy-Duty Crankcase Oils.	C-4-2144 3p	$1.00 per pad
L-5-243	CLR Procedure for Determining in an Engine Oxidation, Ring-Sticking, Detergency, and Bearing-Corrosion Characteristics of Heavy-Duty Crankcase Oils. **Note:** One complete set of these forms is $15.00.	C-5-2144 4p	$1.00 per pad
F-4-443	CFR Supercharge Method of Test for Knock Characteristics of Aviation Fuels	F-4-A 6143 Bond and Tissue	$2.00 per pad
F-4-443	CFR Supercharge Method of Test for Knock Characteristics of Aviation Fuels	F-4-B 6143 Bond and Tissue	$1.00 per pad
L-8-743	Inspection Forms for Radial Air-Cooled Engines		50 to 500 sets – $7.50 per lot of 50 sets 500 sets or more – $5.00 per lot of 50 sets

SAE JOURNAL FIELD EDITORS

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Buffalo – Charles E. Hathorn
Canadian – Warren B. Hastings
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Northwest – D. M. Trepp
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Philadelphia – James J. Crookston
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St. Louis – George C. Davies
So. California – G. A. Zamboni
So. New England – Henry Clay Osborn
So. Ohio – W. H. Geddes
Syracuse – No Appointment
Texas – Tom Ashley
Washington – Fred Fielding
Wichita – No Appointment
Colorado Group – No Appointment
Mohawk-Hudson Group – No Appointment
Muskegon Group – Douglas W. Hamm
Peoria Group – Harry W. Fall
Twin City Group – Frank A. Donaldson, Jr.

Expander Ring Use Explained in Report

RECOMMENDED practices in using expander type cylinder rings have been made to the Office of Defense Transportation by the SAE Maintenance Methods Coordinating Committee.

The report was requested of ODT in view of the necessity for increasing longevity of automotive engines in view of the shortage of parts and new equipment, and to lighten the burden of maintenance expense to motor vehicle operators.

Among others, the report cites these advantages from expander-type cylinder rings:

1. By compensating for cylinder wear, they permit prolonging the periods between engine reconditioning;

2. Increase service mileage of cylinder blocks;

3. Segmented expander rings practically eliminate clogging – except under extremely cold operations, and they

4. Reduce ring sticking caused by over-oiling and blowby, and consequent oil oxidization and corrosion of bearings.

The effectiveness of the expander-type piston rings, however, is limited to ring functions, as is any type of ring.

As a guide to maintenance men, the me-

turn to p. 40

About SAE

C. H. Baxley, above, has been named vice-president of Intava, Inc., a company newly formed by Standard Oil Co. of N. J. and Socony-Vacuum Oil Co. to provide complete services for airplanes at any foreign air base in the world where private companies are permitted to operate, and to supplement an earlier program initiated by Socony and New Jersey Standard through International Aviation Associates, with which Mr. Baxley has been associated for many years

JOHN P. KRIDER, who had been a machinist with Thompson Products, Inc., Cleveland, is now tool die maker for Thompson Aircraft Products Co., Euclid, Ohio.

H. C. NIMERICK has been transferred from Detroit to the Toledo Division of Packard Motor Car Co.

CHARLES CUMA, previously Atlas Imperial Diesel Engineering Co., Detroit, may now be reached at the Chicago branch of the same company.

B. C. ERICKSON is now research engineer, Research Laboratories, Borg-Warner Corp., Detroit. He was previously connected with Packard Motor Car Co., same city.

Formerly employed by Eliott Mfg. Co. of Milford, Conn., **EMERY B. KEREKES** is now chief test engineer for Kellett Aircraft Corp., Plant 2, Upper Darby, Pa.

Named to NACA

WILLIAM LITTLEWOOD, vice-president of American Airlines, Inc., and chairman of the new SAE Air Transport Engineering Activity Committee, has been appointed a member of the National Advisory Committee for Aeronautics by the president. Other SAE members of the NACA are **JEROME CLARKE HUNSAKER,** its chairman; **WILLIAM A. M. BURDEN,** Assistant Secretary of Commerce; **EDWARD WARNER,** vice-chairman of the Civil Aeronautics Board; **ORVILLE WRIGHT,** and **THEODORE PAUL WRIGHT,** director of the Aircraft Resources Control Office, WPB. **GEORGE J. MEAD** has retired because of poor health. Mr. Littlewood has long been active in SAE technical and administrative work, and is chairman of the SAE Aircraft Accessories and Equipment Subdivision and a member of several other SAE committees.

FRED W. LAMPE, previously head of the mechanical engineering section, research laboratory, Airplane Division, Curtiss-Wright Corp., Buffalo, is now product design and development engineer with CAG Products Inc., Dearborn, Mich.

VERNON L. DURRSTEIN is now with the Superior Engine Division, National Supply Co., Springfield, Ohio, as design engineer. He was formerly employed as chief engineer with Harnischfeger Corp., Port Washington, Wis.

JACK S. BEECHLER, formerly chief inspector for Firestone Steel Products Co., Akron, is now acting chief engineer with the Firestone Rubber & Metal Products Co., Wyandotte, Mich.

Previously president and general manager of the Aviation Institute of Technology, Inc., Long Island City, N. Y., **FRANK J. AMBROSE** is now owner and operator of the Frank Ambrose Aviation Co., Whitestone, N. Y. This organization exports airplane and engine accessories.

MILES E. JOHNSON is now chief product engineer for Continental Aviation & Engineering Corp., Muskegon, Mich. He was previously with Draper Motors Corp., Detroit, as engineer.

C. MORGAN RIFENBERGH, previously design and development engineer for Westinghouse Electric & Mfg. Co., Lima, Ohio, is now an independent research and development engineer on aircraft instruments and allied equipment, particularly powerplant instruments and control apparatus. He may be reached at Port Huron, Mich.

ENSIGN RUTH E. SEARLE of the U. S. Navy and Coast Guard is acting as aerology officer in charge of the station's constant study of atmospheric conditions at Port Angelus, Wash. Last fall, Ensign Searle left her engineering position with the Lincoln Forging Co. to join the Spars, and Dec. 15 was among the Spar officers commissioned at the Coast Guard Academy, New London, Conn.

Ensign Ruth E. Searle

WILLIAM B. STOUT, SAE past-president and head of Stout Research Division of Consolidated Vultee Aircraft Corp., was recently appointed to the State Aeronautics Board in Detroit to replace the late **WILLIAM B. MAYO.** His term will expire Aug. 27, 1947.

Formerly product test engineer, Dodge Chicago Plant Division, Chrysler Corp., Chicago, **CARL FREDERICK BREER** is now an ensign in the U. S. Navy, and is stationed at the Bureau of Aeronautics, Navy Department, Washington.

ALBERT L. STICA, a former member of the engineering staff of Edward G. Budd Mfg. Co., is now vice-president of Multi-Engineering Co., Inc. Mr. Stica has just

Albert L. Stica

resumed his duties in Detroit, as executive partner of the Multi-Mfg. Co. in Mount Clemens, Mich., and associate engineer of the Multi-Hydromatic Welding & Mfg. Co. in Detroit, after nearly a year's absence. During this period he was engaged in the management of a series of major subcontract operations in connection with the Army's B-29 bomber project at the Bell operated bomber plants in Marietta and Atlanta, Ga.

Formerly a student engineer with Chrysler Corp., Highland Park, **GEORGE P. SEMPLE** is now designer for the Hydraulic Press Mfg. Co., Mount Gilead, Ohio.

ARTHUR LIND, a sergeant in the U. S. Army, has been transferred from Company D, Headquarters Battalion, Camp Santa Anita, Calif., and may now be reached at Company 3020, 142nd Battalion, Texarkana Ordnance Center, Ordnance Unit Training Center, Texarkana, Tex.

Formerly salesman, engineering service, Adel Precision Products Corp., Burbank, Calif., **JACK P. HORNING** is now manager, Exacto Industries, Los Angeles.

Members . . .

LT.-COM. **MARSHALL J. WATERS** has been transferred from U. S. Navy Industrial Department, Navy Yard, Pearl Harbor, and may now be reached c/o Fleet Post Office, San Francisco.

ARTHUR R. PARILLA, previously connected with Eastern Aircraft Division, General Motors Corp., Linden, N. J., on special assignments, is now project engineer, Stout Research Division, Consolidated Vultee Aircraft Corp., Dearborn, Mich.

J. J. MIZER, previously chief engineer, Walker Mfg. Co., Racine, Wis., is now mechanical engineer for Young Radiator Co., same city.

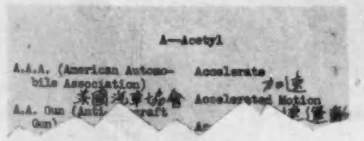
WILLIAM C. RABB, who had been bus division head and transportation engineer for Ford Motor Co., Dearborn, Mich., has

William C. Rabb

been named general manager and chief transportation engineer of Transit Bus Co., Dallas, Tex.

OTTO G. MULLER, who had been engine designer with International Plainfield Motor Co., Plainfield, N. J. (Mack Mfg. Corp. subsidiary), is now service engineer for that organization.

English-Chinese



A. W. HERRINGTON, chairman of the board of Marmon-Herrington Co., Inc., Indianapolis, and SAE past-president, has announced the publication by his company of an English-Chinese automotive dictionary. It is the work of C. C. Chang, who is on the staff of Marmon-Herrington.

IGOR I. SIKORSKY, engineering manager of Vought-Sikorsky Aircraft Division of United Aircraft Corp., recently received the Gen. William E. Mitchell memorial award and the 1943 Fawcett aviation award in recognition of his outstanding work in the development of the helicopter. The Gen. Mitchell award was presented at a dinner of the Early Bird Club, of which Dr. Sikorsky is a member.

ELMER FRANCIS DeTIERE, an ensign, USNR, may be reached at Advance Base Aviation Training Unit, U. S. Naval Air Station, Norfolk, Va.

FRANK M. SMITH, formerly head consultant, War Production Board, Washington, is now general manager of the Stout Houses, Inc., Detroit.

PHILIP C. FAITH, a captain in the Ordnance Department, has been transferred from Red River Ordnance Depot, Texarkana, Tex., and may now be reached at Civil Affairs Officers Pool, A.S.F. Replacement Depot, Camp Reynolds, Pa.

JAMES B. FRETZ, formerly an instructor in the Aeronautical Engineering Department, North Carolina State College, Raleigh, N. C., is now employed by the Fairchild Aircraft Division, Fairchild Engine and Airplane Corp., Burlington, N. C.

CAPT. DAVID M. DEAN is now chief of Operation and Maintenance Materials Handling Equipment, Boston Quartermaster Depot. He was formerly stationed at Camp Ellis, Ill., in the Supply and Service Division.

CHARLES WENDELL SHUBART is now a lieutenant, USNR. He was formerly chief engineer for Mid-Continent Airlines, Inc., Kansas City, Mo.

WILLIAM A. M. BURDEN has been appointed Assistant Secretary of Commerce, having served for several years as special aviation assistant to Secretary Jesse Jones. He was vice-president of the Defense Supplies Corp., Division of American Republics Aviation, Washington.

Dean M. Gillespie

DEAN M. GILLESPIE, past-chairman of the SAE Colorado Group, early in March was elected to the House of Representatives from the First District of Colorado in a special election which attracted nation-wide attention. The first Republican to represent this district since 1930, Mr. Gillespie defeated Major Carl E. Wuertele, a returned AAF officer, who campaigned on a platform supporting President Roosevelt's policies. Mr. Gillespie has widespread business interests and in 1938 was president of the Colorado Motor Car Dealers Association. Mr. Gillespie played a prominent part in the formation of the SAE Colorado Group in the early '30's and has been active in its work.

SAE-T&M Vice-President **ELLIS W. TEMPLIN,** automotive engineer for the Los Angeles Bureau of Power & Light, was co-chairman of the Los Angeles Automotive Council Truck Maintenance Show, March 10 and 11, which was conducted in cooperation with the Office of Defense Transportation.

J. L. COLLYER, president of B. F. Goodrich Co., Akron, Ohio, discussed America's rubber outlook at the ASTM Symposium on the Applications of Synthetic Rubbers in Cincinnati, March 2.

turn to next page

Dr. George Lewis, right, director of aeronautical research, National Advisory Committee for Aeronautics, was awarded the degree of Doctor of Engineering from the Illinois Institute of Technology by Dr. J. E. Hobson, extreme right, director of Illinois Tech's department of electrical engineering. The citation, made with the conferring of the honor, said in part, "For outstanding achievement in advancing fundamental principles and practices of mechanical flight."

EDWARD McVITTY is now assistant division manager of the Atlantic Division of Pan American Airways System, New York Airport Station, La Guardia Field, N. Y. He was formerly division engineer of the same organization.

ELWIN S. TITUS, formerly equipment engineer for Ranger Aircraft Engines, Division Fairchild Engine & Airplane Corp., Farmingdale, L. I., N. Y., is now project development engineer for Robinson Aviation, Inc., New York City.

HAROLD J. DAVIS, who had been an instructor in gasoline engine mechanics for the Board of Education, Brooklyn High School of Automotive Trades, Brooklyn, N. Y., is now in the U. S. Army, and is stationed at Fort Dix, N. J.

Previously head automotive adviser for the U. S. Army, Third Army, Fort Bliss, Tex., **FRED R. MUERDTER** is now a motor machinist's mate (SR) in the U. S. Navy.

RALPH P. DOMJAN is now in charge of preparation of lubrication guides for Service Analysts, Inc., New York City.

SAE student members newly engaged in engineering work at various production plants throughout the country include:

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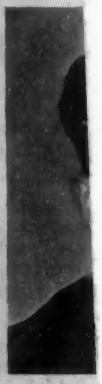
DAVID FEIGENBAUM	College of the City of New York	National Advisory Committee for Aeronautics
RUSSELL A. ELFORS	Northwestern Technical Institute	Lockheed Aircraft Corp.
BERNARD W. HATTEN	Ohio State University	Chrysler Corp.
C. STANLEY LEAF	Oregon State College	Allis-Chalmers Mfg. Co.
WALLACE M. GRUBE	Purdue University	Chrysler Corp.
QUENTIN JA		

MALCOLM
Wellman Co.,
vision manager
Previously proj



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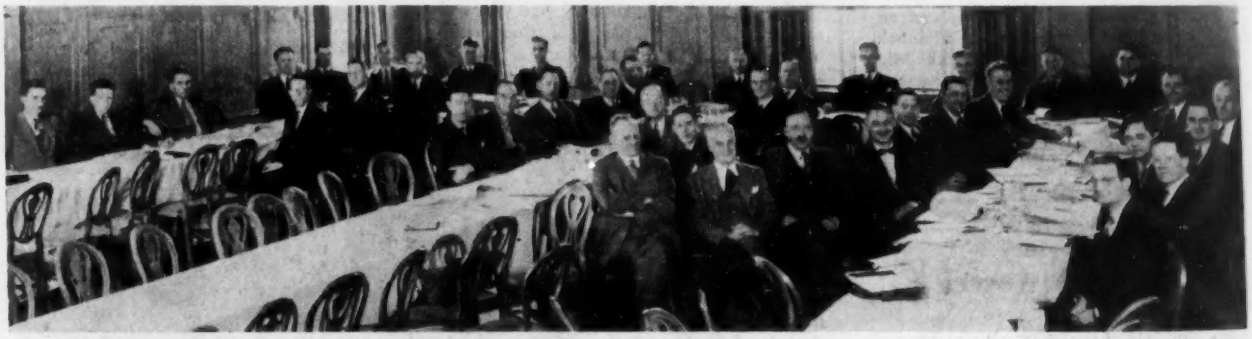
Combined SAE Materials Groups At Work in San Francisco



Conferring for four days in San Francisco, a combined meeting of the SAE Aircraft Engine, Aircraft Accessory, and Airframes Materials & Processes Committees met from Feb. 29 to March 3 to work on a heavy agenda of Aeronautical Materials Specification revisions and new specs. Among the 100-odd Army, Navy and RAF officers and experts, and civilian metallurgists and engineers who attended the meetings, were these shown at the March 2 session:

Left to right, C. Watson, J. W. Welty, T. E. Piper, G. T. Waite, R. E. Pelzel, E. Dudley, R. B. Stringfield, J. F. Cox, L. P. Spalding, R. P. Lippis, Lt.-Com. W. P. Goepfert, G. M. Huck, Major S. D. Daniels, J. A. Chalk, D. H. Rhunke, W. G. Bischoff, and L. D. Bonham, chairman, Airframes Materials & Processes Committee. Grouped around the near table and behind them, left to right, are L. S. Fulton (with arms folded), A. M. Bounds, W. B. Kennedy, E. S. Hudson, E. D. Dixon, J. B. Johnson (at head table) chairman of the Aircraft Materials & Processes Committee; Lt. N. F. Hawthorne, J. D. Redding (at head table), SAE staff representative; J. N. Huff, H. F. J. Scarbek, W. C. Schulte, A. W. F. Green, B. Clements (at head table), chairman, Aircraft Engine Materials & Processes Committee; C. E. Carrigan, D. G. Moffitt and R. L. Heath, (both at head table), British Air Ministry. At this side of the near table, left to right, are J. Mitchell, L. L. Fenall, A. J. Pepin, H. J. Noble, and M. A. Tran. John Cramer was absent from the room when the photograph was taken

NORRIS C. BARNARD, Colonial Beacon Co., is editor of *Niagara Frontier Engineering News*, which made its bow with the March edition. Published by the Buffalo section of the ASME, this monthly bulletin lists the programs of the various engineering organizations holding meetings in the Buffalo area. Mr. Barnard is secretary-treasurer of the SAE Buffalo Section.

JESSE G. VINCENT, vice-president of en-

Major-Gen. James H. Doolittle, right, commanding the Eighth Air Force in England, is shown a few days before he was nominated by President Roosevelt to be a lieutenant general. Gen. Doolittle held the temporary rank of lieutenant colonel

D. McMULLIN has joined Lawrance utical Corp., Linden, N. J., as liaison r. He was formerly assistant chief r for Ruckstell-Burkhardt Mfg. Corp., N. Y.

BERT SCHEEL, formerly engineer-structor at Terrell Aviation School, RAF Unit, British Flying Training Terrell, Tex., is now project engineer iberson Corp., Dallas.

F. ALEXANDER KLEMIN, Daniel nheim School for Aeronautics, New Jniversity, has been appointed a mem- the new SAE Air Transport Engineer-

Prof. Alexander Klemin

Ervin N. Hatch

Metropolitan Section Governing Board of which he is treasurer. He returns to the transit system after more than two years with the American Brakeblok Division, American Brake Shoe & Foundry Co.

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DELOS W. RENTZEL, director of communications for American Airlines, Inc., Municipal Airport, Jackson Heights, L. I., N. Y., has been elected president of Aeronautical Radio, Inc., a non-profit organization owned by the domestic airlines.

ployed by Arizona Motor Transport Association as executive secretary and general manager, with headquarters in Phoenix. He was formerly assistant manager of the transportation department, General Petroleum Corp. of Calif., Los Angeles.

FRED BELL, JR., has been appointed manager of the Chicago branch office of Felker Mfg. Co., Torrance, Calif. Mr. Bell was formerly manager of the Detroit office for Dole Valve Co. in Chicago.

Fred Bell, Jr.

ing Activity Committee (*SAE Journal*, March, 1944, p. 37), WILLIAM LITTLEWOOD, chairman, announced.

KARL KRAMER, formerly product engineer for Leece-Neville Co., Cleveland, is now machine designer for National Advisory Committee for Aeronautics, same city.

JOSEPH A. DOYLE, a major in the U. S. Army, has been transferred from A.P.O. 9061 to A.P.O. 518, c/o Postmaster, New York City.

HARRY T. BENHAM, formerly with Thompson Products, Inc., Bell, Calif., where he worked on production control, is now supervisor of standards at Warman Steel Casting Co., Los Angeles.

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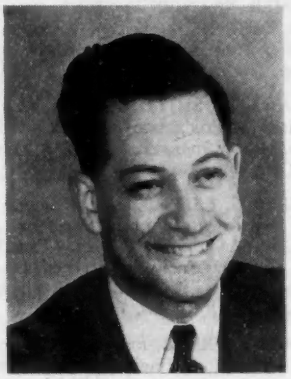
WALLACE M. GRUBE	Purdue University	Chrysler Corp.
QUENTIN JAMES EVANS	Purdue University	S.A.M. Laboratories, Columbia University

MALCOLM S. ADLER has joined S. K. Wellman Co., Cleveland, as automotive division manager with headquarters in Detroit. Previously project engineer in the research



Malcolm S. Adler

laboratory of the same company, Mr. Adler assisted in the development of a friction disc for a mechanical-drive supercharger clutch, now widely used in military aircraft.

C. G. KUSTNER, a lieutenant colonel in the U. S. Army, has been transferred from Camp Sutton, N. C., to Fort Leonard Wood, Mo.

SYLVAN E. BURKE has joined Wright Aeronautical Corp., Lockland, Ohio, as senior tool research engineer. He had been production engineer for Wickwire Spencer Aviation Corp., Blue Island, Ill.

WALTER H. ZIEGLER, U. S. Army Ordnance Department, has been raised from first lieutenant to captain, and may be reached at A. P. O. 729, c/o Postmaster, Seattle, Wash.

PETER GLADE is serving with the Arabian American Oil Co. in Saudi Arabia as an automotive engineer. Mr. Glade, who was Northern California section representative on the SAE Sections Committee before leaving for foreign duty, had previously been automotive engineer for Purity Stores, Ltd., San Francisco.

SIDNEY H. WEBSTER, former advertising and technical data director for Eclipse Pioneer Division, Bendix Aviation Corp., Teterboro, N. J., has been appointed Pacific coast sales and engineering representative of the company, and will make his headquarters in the Los Angeles office.

Combined SAE Materials Groups At Work in San Francisco

Conferring for four days in San Francisco, a combined meeting of the SAE Aircraft Engine, Aircraft Accessory, and Airframes Materials & Processes Committees met from Feb. 29 to March 3 to work on a heavy agenda of Aeronautical Materials Specification revisions and new specs. Among the 100-odd Army, Navy and RAF officers and experts, and civilian metallurgists and engineers who attended the meetings, were these shown at the March 2 session:

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JESSE G. **VINCENT,** vice-president of engineering for Packard Motor Car Co., Detroit, was awarded a fellowship by the Institute of Aeronautical Sciences at the 12th Annual Meeting of the Institute in New York City.

WERNER E. **LERCH,** formerly consulting engineer for Douchkess & Lerch, New York City, is now associated with Ebasco Services, Inc., same city, as diesel engineer in Design and Construction Division.

BRIG.-GEN. **BURTON O. LEWIS** has been transferred from the Boston Ordnance District to the Army Transportation Corps, Washington.

ERVIN N. **HATCH,** chairman of the SAE T&M Activity Meetings Committee, has been appointed senior mechanical engineer-automotive of the New York City Board of Transportation, 994 Third Avenue, Brooklyn. He has been active in the SAE-ODT work, is a member of the SAE-ODT Coordinating Committee and a project chairman in charge of the work of several committees. He is serving his fifth term on the

Ervin N. Hatch

Metropolitan Section Governing Board of which he is treasurer. He returns to the transit system after more than two years with the American Brakeblok Division, American Brake Shoe & Foundry Co.

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Major-Gen. James H. Doolittle, right, commanding the Eighth Air Force in England, is shown a few days before he was nominated by President Roosevelt to be a lieutenant general. Gen. Doolittle held the temporary rank of lieutenant colonel when he led the raid on Tokio April 18, 1942. After this attack he was promoted to brigadier general and awarded the Congressional Medal of Honor

PHILIP G. **JOHNSON,** president of Boeing Aircraft Co., Seattle, has been elected to the board of trustees of the Committee for Economic Development. Mr. Johnson, who serves as regional vice-chairman of the CED for the Pacific Northwest region, is the first aircraft representative on the CED board of trustees.

K. L. **SWARTZELL** is now connected with the Compania Panamena de Fuerza Y Luz in Panama. He was formerly transport superintendent and workshop engineer for Ebasco Services, Inc., New York City.

JOSEPH R. **SEGUIN,** who had formerly been with Chrysler Corp. as experimental layout and precision inspector, is now with Ford Motor Co., Aircraft Engineering Division, Dearborn, Mich., as quality engineer.

JOHN M. **HALDEMAN,** an ensign, USNR, may be reached c/o Fleet Postmaster, New York City. He was formerly at the Army and Navy Engineering Training School, Pratt & Whitney Aircraft, Brainard Field, Hartford, Conn.

MARTIN J. **MURPHY, JR.,** is now employed by Arizona Motor Transport Association as executive secretary and general manager, with headquarters in Phoenix. He was formerly assistant manager of the transportation department, General Petroleum Corp. of Calif., Los Angeles.

FRED **BELL, JR.,** has been appointed manager of the Chicago branch office of Felker Mfg. Co., Torrance, Calif. Mr. Bell was formerly manager of the Detroit office for Dole Valve Co. in Chicago.

Fred Bell, Jr.

RAY D. **McMULLIN** has joined Lawrance Aeronautical Corp., Linden, N. J., as liaison engineer. He was formerly assistant chief engineer for Ruckstell-Burkhardt Mfg. Corp., Elmira, N. Y.

HERBERT **SCHEEL,** formerly engineering instructor at Terrell Aviation School, Inc., RAF Unit, British Flying Training School, Terrell, Tex., is now project engineer for Guiberson Corp., Dallas.

PROF. ALEXANDER **KLEMIN,** Daniel Guggenheim School for Aeronautics, New York University, has been appointed a member of the new SAE Air Transport Engineering Activity Committee (*SAE Journal,* March, 1944, p. 37), WILLIAM **LITTLEWOOD,** chairman, announced.

Prof. Alexander Klemin

KARL **KRAMER,** formerly product engineer for Leece-Neville Co., Cleveland, is now machine designer for National Advisory Committee for Aeronautics, same city.

JOSEPH A. **DOYLE,** a major in the U. S. Army, has been transferred from A.P.O. 9061 to A.P.O. 518, c/o Postmaster, New York City.

HARRY T. **BENHAM,** formerly with Thompson Products, Inc., Bell, Calif., where he worked on production control, is now supervisor of standards at Warman Steel Casting Co., Los Angeles.

turn to p. 48

Expander Rings

cont. from p. 35

dium and large size engine section of the report concluded:

1. Expander type rings can be used to rering above a 0.006 in. taper, whereas plain rings will not effectively compensate for taper above this amount. However, expander type rings can perform satisfactorily when the taper is as much as 0.20 in. but rering-ing is not recommended at this point of wear; and

2. Cylinder taper of 0.16 in. is the maximum economical limit for successful operation.

In connection with small engines, the report said in part:

1. It is practical to rering with expander type rings with cylinder taper not exceeding 0.012 in., except

2. When operating under severe conditions, reboring the cylinder with more comprehensive replacement of parts is more economical than rering.

Members of the Subcommittee on "The Use of Expander-Type Rings to Prevent Excessive Cylinder Reconditioning," of the SAE Maintenance Methods Coordinating Committee, are: P. E. Friend, Wilkening Mfg. Co., chairman; Timothy Baldwin, Jr., Kraft Cheese Co.; J. H. Blohm, Lyon Van & Storage Co.; E. P. Gohn, Atlantic Refining Co.; L. R. Gwyn, Jr., Railway Express Agency, Inc.; G. W. Johnson, Bowman Dairy Co.; P. S. Lane, Muskegon Piston Ring Co.; Fred Marconi, Marconi Service Garage; W. A. Mast, Globe Garage; H. W. Morningstar, Ramsey Accessories Mfg. Corp.; William Schwarze, Jr., White Motor Co.; S. B. Shaw, Pacific Gas & Electric Co., and E. W. Whitman, Republic Aviation Corp.

The project chairman was Mr. Gohn, subcommittee member, who is also vice-chairman of the SAE Maintenance Methods Coordinating Committee.

A trip through the Buick Aluminum Foundry and Forge featured the Feb. 16 meeting of Section D of the SAE Student Branch at General Motors Institute. Standing behind the head table at the dinner which followed the tour are, l. to r.: Sgt. Varnas, E. K. Harris, ROBERT E. GEPHART, ROBERT L. BLACK, W. C. Adamson, R. M. TUCK, JR., E. H. Bankard, C. S. Bruce, P. A. MARTEL, Robert O. MacConnell and Clare Jewell

Rambling Throug Sec

PROMINENT gathering at **CANADIAN SECTION'S** Feb. 16 meeting, with presidents of four tire and rubber companies among crowd of 179 . . .

Robert F. Steeneck of Fafnir Bearing Co. and **CLEVELAND SECTION** appointed chairman of Annual Buffet Dinner Dance to be held at Cleveland Club April 22 . . . he and committee members Jay M. Roth, Robert E. Cummings and R. L. Weide promise a successful evening . . . Finale of March 13 meeting on synthetic rubber consisted of two reels of movies: "Freedom Rides on Rubber," portraying all the processes in production of rubber substitutes, and "Normoyle Tire Test," illustrating some of extensive testing which is being done on synthetic tires . . .

Dinner and music preceded J. E. (Jimmy) Ellor's talk to **DETROIT SECTION** March 6 on the development of the Rolls-Royce Merlin engine, which is an example of collective and organized effort to eliminate or elevate limiting factors which have so far furnished improvements of more than 100% in power output without changing the principal dimensions of the engine . . . speaker discussed the importance of progressing in evolutionary steps concentrated around engines of good basic design, and indicated the necessity for parallel research into fuels, materials and design technique, as these are the chief limiting factors toward greater specific output . . .

Symposium on Personal Airplanes of the Future held by **METROPOLITAN SECTION** March 2 showed trends of advanced thinking, and demonstrated that new fabricating techniques and materials will play important roles in design and construction of tomorrow's personal aircraft . . . Contributing papers were W. Lawrence LePage, Platt-LePage Aircraft Co., who predicted the helicopter's popularity as postwar ship; William D. Hall, Aeronca Aircraft Corp., who said low-powered, medium-priced, high-performance planes will be available; and Franklin T. Kurt, Grumman Engineering Corp., who outlined pilots' preferences as being (1) simplified regulations, (2) plenty of landing places, (3) a good plane at low cost . . .

Picturization of emotions of a soldier advancing into action for the first time and gruesome activities of battlefield shown in film "Baptism of Fire" at **NEW ENGLAND SECTION** meeting March 14 . . . same session featured talk on Manpower and suggested solution of the problem by E. S. Harding, War Manpower Commission . . . explained how a committee was set up in New England to consider draft deferment of skilled automotive mechanics and to get their transfer from less essential work back to garages . . . Plan has maximum probability of success because for first time all phases of motor industry have cooperated to solve a common question . . .

Sesquipedalian Technological Circumlocutions Obfuscate Comprehensibility, or Why to Say It Simply was subject of talk at **ST. LOUIS SECTION** Feb. 15 by J. E. Jury, Business Collaborators, Inc., who described most effective way of presenting material to an audience . . . Pointed out benefits of telling complete story in pictures without necessity of referring to printed material accompanying pictures . . . practiced his preachings by illustrating discussion with slides . . . Technical part of program handled by T. H. Risk, Ethyl Gasoline Corp., who disclosed developments in manufacture and blending of gasoline for post-war use . . . research has proved that by careful selection and blending of stocks, we may have a "knockless" fuel, produced with small quantities of ethyl fluid and of a relatively low octane number according to present laboratory test methods . . . Official War Department Movie, showing a truck assembly line at front and the landings on Munda and Rendova as well as exhibit of lubricating devices rounded up session . . .

Section Reports

Supplementing SAE Past-President A. T. Colwell's talk on "Engineers and Horses" at **SOUTHERN CALIFORNIA SECTION** aircraft engine meeting Feb. 18 was short composite film depicting density in combustion chamber, development of General Motors diesel engine, and actual action of a sodium-cooled valve, which included glass valves run on a real camshaft, bouncing valves, rotating valve, and vapor lock and boiling fuel in the fuel system . . .

Why our combat vehicles have met the combat test explained by Col. Joseph M. Colby, Tank Transportation officer at **SOUTHERN NEW ENGLAND SECTION** meeting March 1 . . . Three contributions from American industry which have made the tank possible, he said, are: (1) controlled differential, (2) aircooled engine, and (3) rubber jointed track. Firepower and armor have been added to these in varying amounts to fit the vehicle for the particular job it has to do . . . stressed the importance of the combat team by declaring "Tanks alone are no good. Infantry alone is no good. It is only when infantry, tanks, artillery and airplanes are used together that the real objective is attained" . . .

New publicity chairman for **SOUTHERN OHIO SECTION** is Fred Heckert, who succeeds T. C. Bosler . . . First synthetic rubber meeting of season March 14 featured paper by Clinton M. Doede, Connecticut Hard Rubber Co., who explained tabulations of effective properties of various substitutes, and told what can and cannot be done with neoprene, hycar, buna, thiokol and so forth . . . also discussed applications of substitutes to definite problems that have arisen both due to pre-war unsuitability of rubber and its wartime scarcity . . .

Annual dinner of **WASHINGTON SECTION** March 13 featured the honoring of Section's past chairmen, among whom were guest speaker and SAE Past-President A. W. S. Herrington . . . W. S. James, SAE president, presented certificates to past chairmen and talked to group about SAE War Engineering Program . . . advocated cooperation among engineers, saying group effort is less a surrender of individual privileges, more a joint sharing of benefits . . . it is this policy which governs the SAE, and which is responsible for its contributions to the war effort . . .

Problem session conducted by **COLORADO GROUP** afternoon of Feb. 15, where chemistry, as a revolutionary factor in oil refining, was discussed . . .

Transportation training programs – truck, bus, railcar and subway – described by William D. Weitz, assistant director of Office of War Training, State of New York, at Feb. 15 meeting of **MOHAWK-HUDSON GROUP** . . . Up to now, he said, most of the driver training program has been focused on public school system in training of 4000 regular drivers and 10,000 substitute drivers, and it has been successful . . . Cited case of a large fleet operator in Pennsylvania who has reduced operating expenses 40% in five years due to this program . . .

Magnesium has a bright future after the war, according to W. R. Caple, Dow Chemical Co., at **PEORIA GROUP** meeting Feb. 28 . . . magnesium alloys, 35% lighter than aluminum, has reached such a state of perfection, the speaker said, that a timber of this alloy, placed in a roof of a building, made a better test at the end of a five-year period than like constructed timbers of iron and aluminum . . . obtained from seawater, the supply of magnesium is inexhaustible . . .

Officers elected for new quarter to **OHIO STATE UNIVERSITY SB** at Feb. 29 meeting were: Henry Kamps, chairman; John Janson, vice-chairman; and Donald Whiston, secretary-treasurer . . . Film, "Flying Fortress," shown at this session . . .

Scope of Materials Papers To Be Broadened, Group Says

TO appeal to all types of engineers, the SAE Engineering Materials Meetings Committee has agreed to include the following request in all letters of invitation to speakers for the forthcoming SAE National War Materiel Meeting, June 5, 6, and 7, in Detroit:

"The type of paper required is one that summarizes the important wartime technical developments in the field of materials being discussed, and one that interprets these developments in terms of future applications in automotive products, pointing out the possibilities opened up and including the economic impact of the new developments.

"This paper must not be like the usual materials paper that merely discusses (often in highly technical language) testing and improved characteristics, but will be considerably broadened in scope to make it of interest to all types of automotive engineers – including design, production, and service engineers, as well as to the metallurgist or chemist specializing in materials. . . ."

W. H. Graves, Packard Motor Car Co., was elected chairman of the committee following the resignation of R. H. McCarroll, who will continue as a member.

Members of the Mechanical Engineering Society of Wisconsin, a student organization at the University of Wisconsin formed by members of the SAE and ASME Student Branches on the campus, are shown below. Back row: Michael Maier, William Wachtl, ROBERT MAAS, ROBERT SKRIVSETH, Norlin Roche, Harold May, CHARLES KADEMIAN, LEE EVANS, John Kwapel and Gordon Duquemin. Third row: Hertel Wallace, WAYNE GARSIDE, HENRY REHR, JOHN KOETTING, Warren Young, J. Calvin Lovell, Merrill Jensen, REINO SALMI, RALPH BUEHLER, RICHARD MANN, Robert Jacobs, William Feiereisen, Prof. D. W. Nelson and Prof. L. A. Wilson. Second row: Richard Wilson, Harvey Friedland, WAYNE MARCOUILLER, ELWOOD BUFFA, F. William Mueller, ROY I. ANDERSON, Donovan Rasmussen, William R. Wendt, Melvin Diels and ARTHUR NELSON. Front row: Georger Kono, PAUL KAESBERG, Theodore Schweitzer, Robert Jirucha, JAMES BOERGER, DARRELL ENGLE, WILLIAM BAKER, Arleigh Larson, Toru Iura and David Oesterle

"Horse Sense" Engineering

cont. from p. 32

is starting production in the world's largest engine factory.

Examples of "horse sense" engineering are aircraft valves, high altitude booster pumps, and aircraft engine bearings. Their development, step by step, is a study in good judgment engineering. The industry abounds with such examples.

Technical IDEAS for ENGINEERS

PRECISION HYDRAULIC TESTING MACHINE with Pendulum Load Indication

MORE ACCURATE, MORE DEPENDABLE FOR PRODUCTION TESTING because:

Pendulum load indicator operates on the natural laws of gravitation. . . This principle of operation is not affected by temperature changes or subject to metal fatigue. . . . *Write for descriptive literature and quotations.*

Other Products: IMPACT TESTERS · VICKERS HARDNESS MACHINES · BRINELL HARDNESS TESTERS · MEASURING INSTRUMENTS

Chrome Plating

cont. from p. 27

available for rewetting the surface after load removal, preparing it for its next load cycle.

The desirable surface geometry for boundary lubrication consists of highly polished flats interspersed with pores or channels that are all below the plane of the plateau. This is precisely the geometry of an edge section through porous chromium.

Inspection of Porous Chromium Surfaces—Experience has demonstrated the importance of the porous chromium surface condition.

Visual examination with a 50-power microscope has been reasonably successful, but does require considerable training.

Work is progressing on the adaption of the photoelectric cell as a measure of porosity. We have connected a high-vacuum photocell to a vacuum tube circuit that contains a microammeter. When the instrument is properly calibrated, the meter reads directly in per cent porosity.

Sulfide Printing Porous Chromium Surfaces—In the production of porous chromium, it is most desirable to have available a method whereby the size and contour of the surface porosity of large numbers of engine cylinders can be recorded for future reference. Such records are vital to production, inspection, and engineering departments.

We have recently developed a contact sulfide printing process that may recall a well-known method of locating sulfide segregations in metals. Some of the precision and the perception of depths obtained by good photographic technique are sacrificed in this procedure; however, it has the required speed, simplicity, and portability, and it seems well adapted to the routine registration of porosity size and contour, especially of the channel type of surface. Relatively large surface areas may be recorded on a single print, whereas the curvature of cylinder walls limits photographic methods to quite small sections. The patterns may be readily magnified by optical projection.

This method of recording porosity patterns depends upon the impregnation of the recessed portions of the surface with a moist paste containing sodium sulfide, which, upon contact with the silver halide emulsion of a photographic film or print paper, will cause the development of brown silver sulfide corresponding with the pores.

Fig. 3 is indicative of what may be accomplished by this printing process. It contains prints taken from airplane-engine cylinders having the oil groove or channel type of porosity. The porosities of the cylinders from which these prints were obtained were estimated to be about 35% for the print to the left and 40-45% for the print to the right.

Post-War Promises Large Stock of Cheap Aluminum For Redesigned Vehicles

by L. W. KEMPF,
Aluminum Co. of America

1944 *Annual Meeting*

(Excerpts from paper entitled "Considerations Regarding the Post-War Utilization of Aluminum and Magnesium")

WIDE scale use of aluminum in passenger cars will be economical after the cessation of hostilities in Europe because:

1. Rates at which aluminum is now being used promise sufficient secondary metal to stabilize the market at a low price, and

2. Mass production methods, together with lessons currently being learned about fabricating aluminum, should result in manufacturing aluminum parts at no great premium over the end product cost of pre-war materials.

Even at the pre-war price of 20c per lb for primary aluminum, the automobile industry found it economical to use pistons of this material in large quantities. When the price of secondary metal dropped to 7 and 8¢, considerable use was made of these grades for cylinder heads and intake manifolds. The demand, which reached its peak with about 35 lb on a small portion of the industry's output, forced the price of secondary to nearly that of primary aluminum. This reversed the trend of aluminum use in automobiles.

However, for long periods during the pre-war era the prevailing price of secondary aluminum ranged from a third to a half of that of primary. Thus it appears that secondary will cost about 5¢ per lb, which is about equivalent of 1¾¢ per lb of cast iron.

Currently, secondary is being produced at the rate of about 58 million lb per month, or about 700 million lb per year, most of which is being used, but surpluses are accumulating at an accelerated rate. About 160 lb of the metal would be required to completely aluminize the powerplant of a 3200 lb, six-cyl car. It appears that there will be enough metal, at stabilized low prices, to put 500 lb on 3 million cars a year after the war.

It is not generally believed that there will be many design changes in automobiles immediately following the war. But within three years following the cessation of the war in Europe new designs will be coming out, and for these new models aluminum quite properly should be considered. At that time there will be sufficient secondary to meet the demand.

Two types of aluminum will be available after the war:

1. Primary metal as it comes from the reduction pots and containing a few tenths of 1% each of iron and silicon, and

2. Secondary aluminum, recovered from scrap metal, with between 3 and 4% copper, 1% or less each of silicon, iron, and manganese, and with smaller amounts of magnesium and nickel.

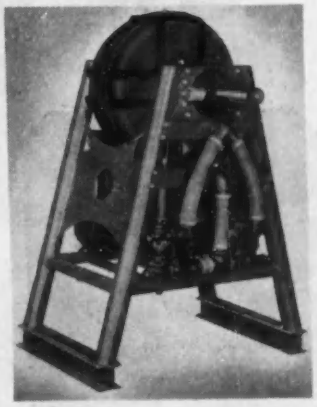
Secondary metal will not be satisfactory for all applications. Whenever the maximum in any single property or combination of properties is necessary, primary aluminum will be used. This is true for both castings or wrought parts.

However, grades of secondary probably will be available to design wrought products which will develop, in the fully heat-treated condition, tensile strengths of from 60,000 to 65,000 psi, with elongations from 10 to 15%.

Casting alloys present a different picture, and the wrought alloys will not be satisfactory because the magnesium content will be too high for required toughness and ductility. Magnesium can be reduced during the recovery process to less than 1%, and either copper or silicon or both must be increased to make the metal commercially castable. These alloys could be heat-treated to tensiles of about 35,000 psi – providing low ductilities could be permitted. If maximum ductility is desired, the castings could be

In modern warfare, extra engine power may often be the margin of victory. This extra horsepower depends on the instant, accurate testing of new, overhauled or rebuilt engines—so that the power plant in every tank, truck, plane or motorboat operates at top efficiency.

Such a program was made practical by Clayton *Hydraulic Dynamometers*, in which a "tank of water" is the heart of the laboratory-accurate testing equipment. Engine performance is checked over its entire operating range. Necessary adjustments and repairs are instantly indicated, insuring extra horsepower when the engine goes into action.



For overseas service, the lightweight, self-contained dynamometer illustrated above is simple and accurate . . . built with a minimum of critical materials. In base shops where water is critical and portability essential, it requires no outside electric current or cooling supply.

Other Clayton dynamometers test aircraft, marine and stationary engines in production plants and in the field. The complete line includes models from 50 to 4000 H.P. for laboratory and production testing—shown at the right is a dynamometer developed for aircraft engines.

CLAYTON
MANUFACTURING CO.
ARMY E NAVY
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annealed to from 23,000 to 25,000 psi and 2 to 3% elongation.

Use of secondary will not be simple. On the contrary, it will be essential to strictly control overall processes from scrap recovery melting to final application. Hence the organization which has the best control over all factors will get the most uniform product, and the automobile industry has achieved rigid controls and uniformity to attain its economical high production rates.

Jobbing foundries cannot achieve the economies inherent in specialization, and should the automobile industry decide to take advantage of aluminum's weight saving, there can be no doubt about the results.

Even with the hundredfold expansion in magnesium production brought about by the war, castings and wrought products from this metal may be expected to cost several times as much as of iron or steel. There will probably be no large secondary market, and the metal is inherently more difficult to fabricate. It appears that magnesium will find its principal market in the aircraft industry after the war.

What Would You Do About A Problem Such As This?

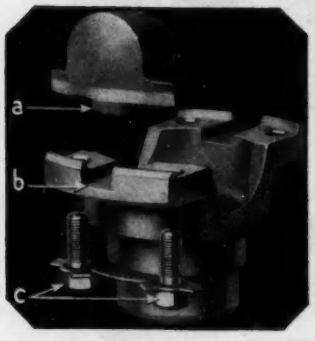
INTER-OFFICE MEMO:
Let's try to get a higher factor of safety in the universal joints for our 194X model.

If You Specify

MECHANICS

Roller Bearing

UNIVERSAL JOINTS



— you will increase the safety factor — because heavy, machined keys (a) and corresponding keyways (b) transmit the torque in MECHANICS Roller Bearing UNIVERSAL JOINTS. The only function of the cap screws (c) is to hold the bearing in place. Let our engineers show you how this and other MECHANICS advantages will benefit your new or improved models.

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Borg-Warner Corporation
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Warplanes, Torpedo Boats, Spawned by Peacetime Contests

■ Detroit, Feb. 7

(Summary of talk on Development of the PT Boat by Hubert Scott-Paine, pilot, racer and naval architect)

THE motor torpedo boat of the United Nations is an offshoot of power boat racing of the past 30 yr, and the Spitfire is lineal descendant of the Schneider Trophy racing planes, according to Hubert Scott-Paine, designer of the PT boat and pioneer in naval architecture.

Mr. Scott-Paine, in his tale of 28 yr of trying to "put a new idea over to the world," said that the first thought of this type of power boat "came into real fighting form in 1917." The chief disadvantage in attempting to use aircraft for distant patrol work lay in the fact that with the failure of daylight, "eyesight touch" with the enemy was lost. The speaker told how he pondered on the possibility of some kind of night liaison so the patrol work could be carried out to some extent during the night. The goal then was a floating vessel that could not be torpedoed, which must have speed and maneuverability to an unusual degree but without a hull deep in the water.

In 1927, Mr. Scott-Paine started to build the antisubmarine boat. After five years he abandoned model trials in water tanks and built 23 ft models for running tests. He related the opposition of marine engineers when he proposed to put a lightweight aircraft engine in his boats, but he declared that the engine in an aircraft has a tougher job to do than in pushing the boat around. By attempting to convert the engine to marine use, he said, he obtained initial full-scale experimentation with shafts, propellers, heat exchangers, ahead and astern gears, V-drives, propeller struts or brackets, exhaust pipes, and cooling and silencing arrangements.

Most interesting of the discoveries, he declared, were the propellers. Despite the opinion of naval architects that successful propeller performance cannot be achieved at 1000 rpm, the first of his motor torpedo boats ran at propeller speeds of 2500 rpm. with a normal 20 to 22% slip. Recent 70 ft boats powered with three Rolls Royce Merlin 1000 hp engines ran propellers above 3000 rpm with an average of 19 to 21% slip.

Using a high speed propeller, the propeller and shaft diameters are considerably reduced, the speaker explained, and torque reaction is lowered to a relatively negligible quantity and engine installation angles are reduced. Mr. Scott-Paine recounted that the development of the leading edge of the propeller blade became one of the most important problems.

Although aiming at development of an antisubmarine vessel, the first of the 64 ft high speed boats built by Mr. Scott-Paine was born in 1934 as a deep sea rescue vessel for the RAF. This was preceded by a 40 ft boat capable of carrying 2¼ tons for 100 hr at 40 knots. These boats, he said, were armored target boats used by the RAF for high altitude bombing experiments. Although

unable to see the boat from high altitude, the airplane could see the feather of the wash behind it and drop their bombs accordingly. As deep sea rescue vessels these craft have operated at speeds of 38 to 40 knots in all theaters of war.

After the boats met with the approval of the Royal Navy, Mr. Scott-Paine said he brought a sample boat to the United States in 1939, and ran trials for the special Navy Boards from September to December in some of the "worst patches of water off the Atlantic coast." The vessels were finally accepted by the U. S. Navy and designated as PT boats.

High Costs, Unsolved Problems, Retarding Helicopter Progress

▪ Philadelphia, Feb. 9

(Summary of a talk on Helicopters, by Col. H. F. Gregory, U. S. Army Air Forces, Wright Field)

EXPRESSING doubt as to whether the helicopter would develop as a popular vehicle in the immediate post-war future, Col. H. F. Gregory, U. S. Army Air Forces, Wright Field, Dayton, Ohio, said, in discussing the helicopter, that it has unlimited possibilities, but many problems are unsolved. He feels definitely, however, that it has practical possibilities as a commercial vehicle.

He stated that a two-place helicopter of 150 hp, if in substantial production, could be sold for under $5000. A four-place machine would be higher.

The colonel explained that the helicopter is sustained in flight by direct application of power to the rotors. In case of failure of the power source, he went on, it becomes in effect an autogiro and continues in gliding flight to a landing. This is accomplished by reducing the pitch of the blades and setting them so as to maintain autorotation. He disclosed that the helicopter is able to hover or move as slowly as desired in any direction, while the autogiro must maintain a speed of at least 30 mph to sustain flight.

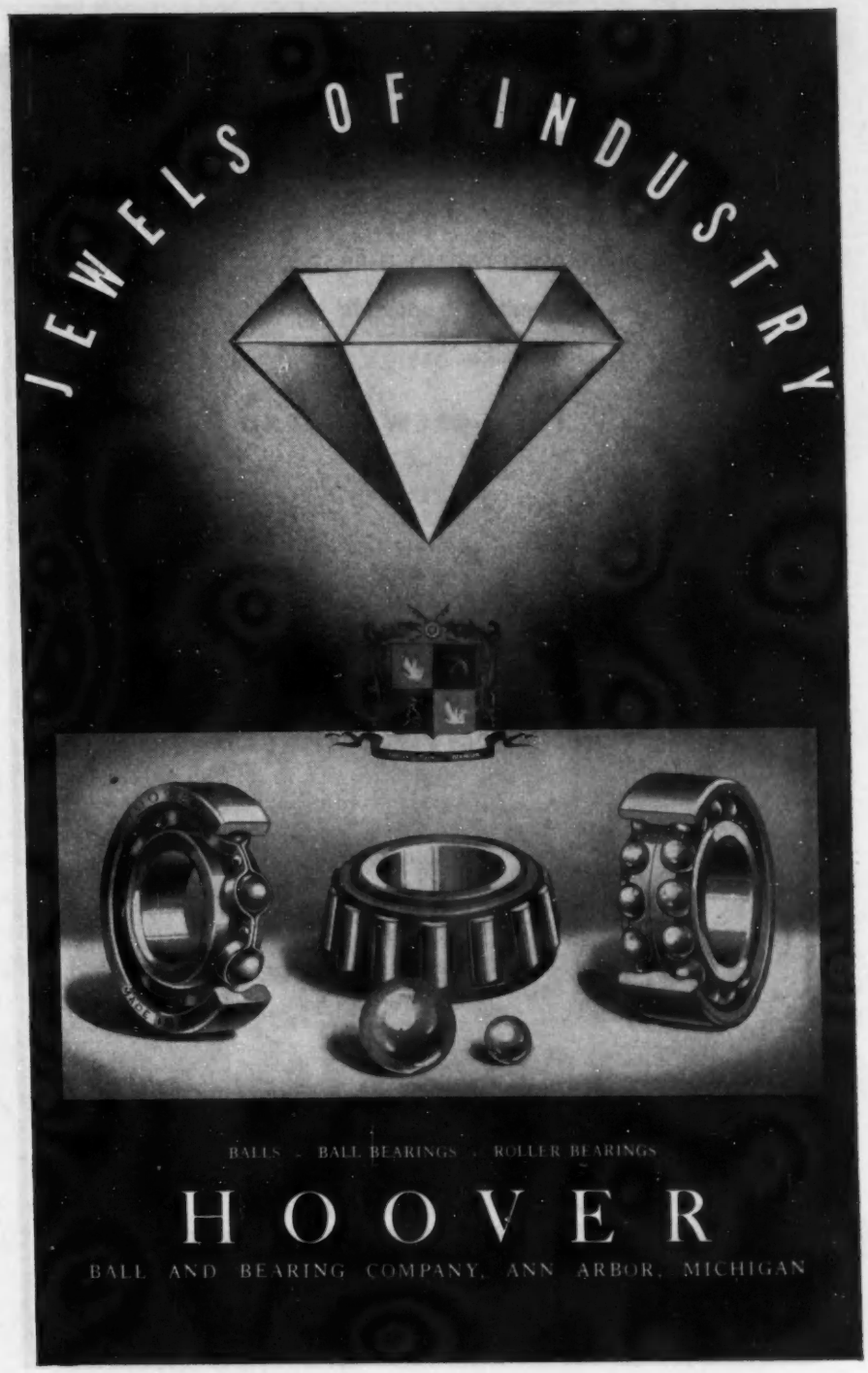
Discussion

Col. Gregory declared that the construction of machines of 8 to 10 tons gross weight seems imminent. Speeds at present do not exceed 150 mph, but he said there is reason to believe it might rival the speed of the present airplane. He said that the useful load, including fuel, can be a maximum of about 40% of the gross weight, which compares favorably with the airplane. The lift varies from about 10 to 14 lb per hp.

Replying to a question as to what factors limited the size of the helicopter, Col. Gregory answered that loss of advantages such as maneuverability and the ability to land on small areas are the major considerations.

At the suggestion that increase in size of the rotor involves reduction in speed of rotation, which in turn introduces serious problems in gearing and the handling of the resulting build-up of torque, one of the audience asked why the lift could not be improved by increasing the number of blades rather than the size of the rotor. Col. Gregory's comment was that the disc area is the critical factor in lifting ability. The disc loading is a primary function. Three blades are usual in rotor design, he said, but four provide smoother performance.

When asked for figures on cost per ton mile of operation, the colonel disclosed that the normal useful load is 20 to 25% of the gross weight. However, it was pointed out that the helicopter offers greater selectivity in design characteristics than the airplane, so that possibilities of economical, commercial use are broad. Also, the helicopter is internally much quieter than the airplane when in motion, and permits normal conversation even when hovering. In case of engine failure, a discusser said, autorotation is achieved immediately when traveling at speed, but only when hovering requires an altitude of 100 ft or more to establish gliding flight.



NEW MEMBERS Qualified

These applicants who have qualified for admission to the Society have been welcomed into membership between Feb. 10, 1944, and March 10, 1944.
The various grades of membership are indicated by: (M) Member; (A) Associate Member; (J) Junior; (Aff.) Affiliate Member; (SM) Service Member; (FM) Foreign Member.

Baltimore Section: John Lawson Senior, Jr., (M).

Buffalo Section: Paul Dubosclard (M).

Canadian Section: James Gordon Stafford (J).

Chicago Section: Norman Eric Bateson (M), George V. Frushour (J), Emanuel V. Lansky (A), Charles S. Longstreet (J), Michael Joseph Reardon, Jr. (J).

Cleveland Section: Wayne S. Aldrich (J), John Borland (M), Richard J. Cerny (J), Harold J. Curtis (J), Robert H. Green (J), Robert Oscar Hickel (J), William C. Jenkin (M), Robert J. Koenig (J), Steve R. Muza (J), Robert Donald Oldfield (A), Wilbert Steffy (M), William D. Watkins (A), William M. Wilks (A).

Colorado Group: Robert W. Porter (A), T. M. Sanders (A), Jake Sterkel (A).

Detroit Section: Arthur F. Baske (J), John William Carson (J), Alex Csizmansky (M), Roman Basil Cuzack (J), Robert Thomas Doughty (J), Herman T. Dreyer (M), William E. Drinkard (M), Carl O. Durbin (J), William Esdale (A), Jerald E. Foley (J), Victor Albert Ford (A), Charles H. Frick (A), Sidney M. Gamsu (J), Frank John Gardiner (J), Lewis R. Hetzler (J), Nelson J. Kreider (A), Harold J. McCotter (M), Robert E. Mooney (A), William Rina Munford (J), Clarence W. Myers (M), William R. Patterson (A), W. Harold Peet (M), Roy W. Roush (M), Claud S. Semar (A), E. B. Sorensen (A), Hugh E. Sorensen (A), Peter C. Sorvick (M), Edward W. Stoehr (J), Charles K. Taylor (J), Arthur P. Woods (M), B. Donald Zannoth (J).

Indiana Section: Myron C. Hunt (J), Ceburn Parker (A), Harold C. Rowe (A), Weldon E. Rugh (J), Albert Warren Sherk (A).

Metropolitan Section: Yura Arkus-Duntov (M), Zachar Arkus-Duntov (M), Donald V. Barker (A), Lt. Fred E. Cochran (SM), Delbert G. Faust (M), Arnold Clarence Fields (J), Cameron Douglas Flanigen, Jr. (J), Sebastian Flores (J), Reynolds M. Garrett (A), Jack G. Gould (A), Stanley M. A. Grabowski (J), Max Granoff (A), Jack F. Greathouse (J), Hou-Yuan Kiang (M), John A. Kimberley (J), Francis J. Kirchman (J), Mathias Klein (M), Carl E. Lane (A), Lt. (jg) Benjamin J. Lehman (J), Henry D. W. Loeffler (M), Clarke Alden Rodman (J), Reginald H. Runge (A), John Sasso (M), James A. Scott, Jr. (J), James W. Scott, Jr. (J), Abram August Shampanier (A), I. C. Sleight (J), Martin Stark (J), Frederick Godfrey Stehman (M), George E. Ternent (J), William D. Thomas, Jr. (M), Carl O. Tongberg (M), Harry R. Weber (J), Louis F. Werner (A), Robert U. Whitney, Jr. (J), Arthur W. Yoder (J).

Milwaukee Section: Frank Anton Grabarczyk (J), Leo J. Lechtenberg (J).

Muskegon Group: Somers E. Blackman (J), Kenneth M. Cloud (J).

New England Section: Alfred S. Hunt (A), R. Casper Swaney (M).

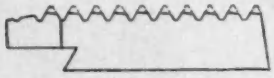
Northern California Section: Harry Bradford Chin (J), Lt.-Com. Arthur Clyde Jenkins (S M), Edwin Edward Richter, Jr. (A), Alfred M. Salmon (J), Walter V. Scholz (J), Urban B. Stair (J), Philip Richard Wong (S M), Richard A. Young (J).

Northwest Section: Ben M. Anderson

IT'S A FACT

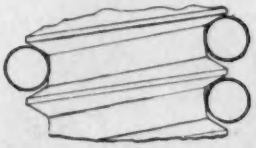
Exhaustive tests have proven that the NEW AMERICAN NATIONAL DARDELET STUD THREAD DESIGN contributes many desired results. *Production* and *Inspection* follow STANDARD PRACTICES.

THE SCREW THREAD

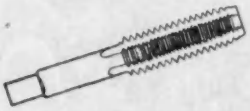


. . . can be chased or rolled by simple modification of A.N. tools.

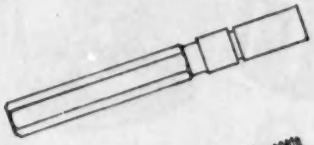
. . . and inspected by any wire type gage without change. As simple as square thread gaging.



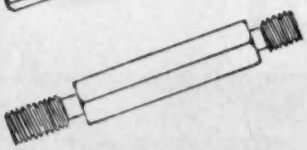
THE RECEIVING THREAD



. . . is formed by reaming to commercial limits before or after tapping with any American National tap (class 2 preferred).



. . . "GO" and "NO GO" plug gage used for tap hole.



. . . gage threads by standard A.N. "GO" and "NO GO" thread gage.

Since the stud is tapered .003 to the inch toward the end and the required limits for reamer are commercial, we see no reason for oversized studs in the field or for selective assembly.

DARDELET THREADLOCK CORPORATION
2832 E. Grand Boulevard, Detroit 11, Michigan

(J), M. G. Barlow (A), Earl P. Bartholomew (A), Wilson Henry Davenport (J), Ralph H. Doggett (A), J. M. Farnsworth (A), Paul H. Grimm (A), Wm. B. Keith (A), Charles Kendzur (A), George A. Reid (A), Robert Lester Scott (A), Merritt N. Smyth (A), Walter T. Thorsen (A).

Oregon Section: Louis Courtemanche, Jr. (A).

Peoria Group: John A. Junck (J), Robert J. Sullivan (J).

Philadelphia Section: Harry S. Egerton (J), Charles Cochran Miller, Jr. (M), Richard Hickman Prewitt (M).

Pittsburgh Section: George Nelson Schramm (M).

St. Louis Section: William H. Bruce (J), Harold A. Carlson (M), B. E. Garner (M), Bernard J. Murphy (M), Kennedy Smith (J), A. D. Stauffer (M).

Southern California Section: Max Alex (M), Ernest V. Berry (M), Harold Victor Bordeaux (A), Fred D. Bowlus (M), Robert H. Braun (M), Edwin J. Burnell (M), Alfred A. Gilford (J), John W. Hazen (M), Dale Herman (M), Milo C. Ketchum (M), August Martin (M), Overton A. Phillips (A), Hugh Otis Pierce (J), Linwood T. Root (J), William H. Shallenberger (M), Hamilton W. Smith (A), Walter Charles Walling (J).

Southern New England Section: Avery L. Bond (J), William P. Cross (A), Donald Stewart Ford (A), Carl. Holstrom (A), Norman F. Jones (J), Bernard Freshney Shattuck (J), John Craig Steele (J), Lt. (jg) Robert Henry Thorner (J), Walter Robert Wykoff (J).

Southern Ohio Section: Warren D. Berkley (J), Howard William Cole, Jr. (J), Frank C. Croxton (M), Louis Lindenbaum (J), Charles E. Pruden (A), Kenneth D. Reed (J), Lester W. Reineck (J).

Syracuse Section: Harold E. Perry (A).

Texas Section: Waldo C. Cole (S M), William Hassell Fain (A), George Edward Haddaway (A), Lawrence Robert Schwedes (J).

Twin City Group: Richard E. Dahlstrom (J), Harold S. Pew (A).

Washington Section: Lt. (jg) Eric P. G. Bloomfield (J), Gordon Camden (A).

Wichita Section: W. R. Brown (J), William Alvin Day (M), Horrell Gus Erickson (M), Gomer W. Jones (J), J. B. Wiley (J).

Outside of Section Territory: Joseph Enos Aflague (A), Milo M. Bolstad (M), Major Arthur F. DeLong (A), Roy Gunard Frogness (J), 2nd Lt. John Russell Hahne (J), Arnold E. Mareneck (A), Wesley S. Roper (J), Sidney L. Shannon (M), William J. Weber (J), Lt. (jg) Murray Weiss (J), Ensign Robert Reed Woodcock (J).

Foreign: Eric Harry Leach Cooper (F M), (England), Cyril Harding Sprake (F M), (England), Alfred John Thorne (F M), (England).

APPLICATIONS Received

The applications for membership received between Feb. 10, 1944, and March 10, 1944, are listed below. The members of the Society are urged to send any pertinent information with regard to those listed which the Council should have for consideration prior to their election. It is requested that such communications from members be sent promptly.

Buffalo Section: C. William Sidwell.

Baltimore Section: Capt. J. A. Hutchinson, Jr., Albert V. Zimmerman.

Canadian Section: Carl B. Cooper, O. D. Cowan, Charles Nevin Fouse, Albert Granik, Joseph R. Jagger, Earl F. Laforest,

David Dunseath McMillan, Alfred Hugh Paton, J. H. Douglas Wilson.

Chicago Section: Paul Bard, William F. Blakeway, Ralph R. Gunderson, Hubert Hollmann, John E. Menaugh, Clarence W. Wandrey, C. S. Winston.

Cleveland Section: Clarence W. Custer, H. W. Delzell, John A. Diehl, W. Bryant Gemmill, Harold L. Ginaven, Morgan P. Hanson, Carl L. Meyer, Preben John Peterson, James Gilbert Ruspino, David W. Scott.

Colorado Group: Victor H. Freeburg.

Detroit Section: Delmer E. Ahrens, S. F. Baker, William B. Baildon, Alfred Lindley Boegehold, John A. Boll, George F. Bunte, Herman M. Canner, Oscar B. Chapin, John A. Ciupak, Robert M. Currie, Louis Drobeck, Louis R. Gelfand, John Harris, Charles Hicks, Clarence R. Hoofnagle, Marshall H. Johnson, Richard Bruce Johnson, Theodore R. LaVallee, Arthur MacNall, Clarence R. Makin, Alexander Nicholas Melnichuk, L. H. Nagler, Emil Podlesak, Reinhardt N. Sabee, Hubert C. Smith, Ervin H. Strem, Gosta Vennerholm, Peter Zerhan, Jr.

Indiana Section: C. Lynn Akers, Willard T. Nickel.

Kansas City Section: William R. Turner.

Metropolitan Section: George S. Armstrong, Mario Ascarelli, William G. Ball, Jr., Murray A. Cabot, Thomas Preston Darby, Albert P. Elebash, Lars Niclas Enequist, Barnard D. Gross, Raymond E. Hall, Samuel J. Hall, Arthur B. Marsh, Joseph Mason, Jr., Peter James McLaren, O. Stewart Michael, Arthur Dunn Nordhem, Alan E. Park, Edgar S. Peierls, Melvin Pine, Fred R. Pinter, Irvine Emerson Ross, Jr., Yu-Ching Wang, Daniel C. Wendel, Daniel W. Witkin.

Mid-Continent Section: G. L. Wheatly.

Milwaukee Section: John Anglim, Sherman C. Heth.

Mohawk-Hudson Group: Joseph R. Harkness, Edwin J. Van Riper, B. S. Weaver.

Muskegon Group: Arnold G. Andersen, Harry P. Bitzer, Harold G. Seamans, Marvin A. Ziehms.

New England Section: Herbert Lorimer Bishop, Dwight M. Church, Wilmer H. Churchill, Richard H. Dassler, Clarence Crocker Eldridge.

Northern California Section: Frank Woodward Commins, Walter Gasser, E. George Harlow, Ray F. Heinze, Paul E. Peterson, Jack A. Wigholm, Earle C. Williams.

Northwest Section: L. E. Gruennert, Ivan Edward Lundstrom, John M. Neal, J. H. Robblee, Turner Grafton Timberlake, Edward H. Williams.

Peoria Group: Alexander Goloff, Richard Wiebe.

Philadelphia Section: F. Marple Ambler, George D. Conlee, James Jeffery, Thomas D. Joeck, Andrew M. Maxwell, John F. McGrogan, Paul L. Shuman, Vincent Joseph Zardus.

Pittsburgh Section: William A. Royston, III.

St. Louis Section: Murty R. Callahan.

Southern California Section: James M. Barr, Everitt A. Carter, Robert B. Connor, Thomas Matthew Dahm, Clifford P. Graham, Leroy Leon Olson, G. D. Lovell, J. Theadore O'Neil, Kenneth B. Owings, Carl F. Schmidt, J. Arthur Scott, Alvin Ernest Shumate, Lewis W. Teel, Harold Joseph Varhanik.

Southern New England Section: Pierre Henry Bauer, Robert E. Johansson, James Woodward Lewis, Oren F. Parker, Davis G. Phinney, Robert H. Starrett, Victor F. Strojny.

Southern Ohio Section: Harold F. Marshall, Alva W. Scott, Ralph Joseph Van Paepeghem, Alexander M. Wright.

Texas Section: Howard B. Hill, William Farnsworth Orr, Henry Zunker.

Twin City Group: Robert M. L. Lindquist.

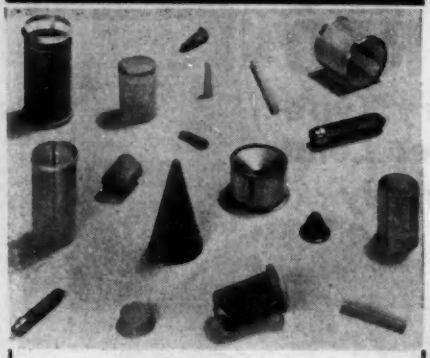
Washington Section: T. W. Delury.

Outside of Section Territory: Robert Thomas Blackmore, Oscar U. Cook, Carroll D. Fruth, Paul C. Hosking, Lt. Frank C. Keller, William R. Lacefield, James W. Massey.

Foreign: Tom Brown, England, Arthur William Judge, England, William Swallow, England, Francis Charles Tickell, England.

DO YOU USE WIRE CLOTH

STRAINERS?



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Complete manufacturing facilities for drawing the wire · weaving the cloth · and fabricating the assembly all in one continuous production line.

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About SAE Members

cont. from p. 39

RUSSELL H. JOHNSON, a major in the U. S. Army Ordnance Department, is now attached to Headquarters, Army Service Forces, Washington. He was formerly with the Commanding Army Specialized Training Unit, Lehigh University, Bethlehem, Pa.

COL. F. W. HUNTINGTON has been transferred from the Army Service Forces, Jackson Barracks Area, New Orleans, La., to the Replacement Training Center, New Orleans Army Air Base.

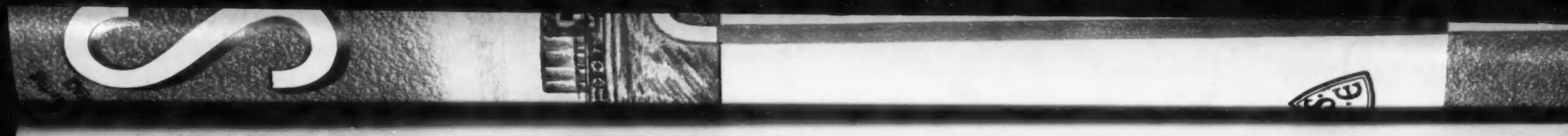
LT. GEORGE W. LANE, AAF, is in the Air Transport Command as assistant engineering officer stationed at Presque Isle, Me. He was formerly senior test engineer for Wright Aeronautical Corp., Paterson, N. J.

CAPT. B. CHATTERJEE, formerly superintendent of workshops, Benares Hindu University, Engineering College, Benares, India, is now senior regional inspector for the Department of Labor, Government of India.

OBITUARIES

Henry George Hellier

Henry George Hellier, who had been internal combustion engineer for Trinidad Leaseholds, Ltd., Pointe-a-Pierre, Trinidad, B.W.I., died recently at the age of 38. A native of England, Mr. Hellier had attended Bournemouth Technical College and Portsmouth Engineering College, both in that country. He had been employed in the automotive industry since 1921, and for several years had been automobile engineer for United British Oilfields of Trinidad.

Capt. Thomas Ball

Capt. Thomas Ball died recently while on active duty with His Majesty's Forces somewhere in the Middle East. He was 32 years old. Before entering the service at the outbreak of the war in 1939, had been employed by Shell Mex & B. P. Ltd., Motor Repair Center, Cardiff, Wales, as motor repair shop engineer. He had attended Harris Institute in Preston, England, where he obtained the Higher National Certificate in mechanical engineering.